Resistivity tomography is an advanced electrical method used in engineering and environmental geophysics to map geological and man-made features in the subsurface to depths of up to 50 m.

**PRINCIPLES**

Soil and rock resistivity varies primarily as a function of variations in porosity, moisture content, pore-water chemistry, matrix material and porosity interconnectivity. Resistivity techniques generally utilise a minimum of two current electrodes and two potential electrodes inserted into the ground. A low frequency alternating current (not DC as this causes electrode polarisation) is applied between the current electrodes. As the ground is resistive, a potential gradient is induced that can be measured as a voltage between two potential electrodes. The measured resistance is the ratio of the measured voltage to the applied current.

The geometrical arrangement of the electrodes is taken into account to convert resistance (ohms) to apparent resistivity (ohm.metres).

Most ground resistivity surveys undertaken in engineering and environmental applications use multi-electrode arrays deployed in a method known as electrical resistivity tomography (ERT). Electrode arrays are connected to a computer via a transmitter/receiver unit; acquisition software controls the electrode configuration and by varying the active electrode spacing a two dimensional profile of apparent resistivity against depth may be generated.
Care and experience are required to select the optimal array type and survey geometry because they can have a first order effect on the ability to resolve a target. For investigation of geological features including characterisation of ground strata a Wenner array is commonly used, whereas discrete targets such as mineworkings are better resolved using a dipole-dipole array.

APPLICATIONS
- Pipeline / cable routes
- Stratigraphic profiling
- Fault mapping
- Natural and man-made cavity detection
- Large sewer and pipe location
- Landfill integrity investigation
- Contaminated land studies
- Hydrogeological investigation
- Soil corrosivity assessment
- Cathodic protection design
- Ground earthing design

METHOD
Electrical imaging surveys require the insertion of many metal electrodes into the ground (approx. 10-20 cm), commonly ranging from 24 to 128 electrodes per profile. The ground surface should therefore be amenable to electrode insertion.

A multi-core cable connects the electrode array to a transmitter/receiver unit and a field computer. A typical single ERT profile generally takes 1-2 hours to acquire after electrode arrays have been deployed. Longer survey lines can be easily achieved by ‘rolling-along’ cable arrays to produce continuous sections, in this way, survey line lengths of several km are quite feasible.

Preliminary processing of the results can be made in the field to assess data quality. Resistivity data can be processed using sophisticated software programmes and displayed as 2D or 3D colour images showing both vertical and lateral changes in ground resistivity which can be interpreted for geological or engineering significance.

SITE CONSIDERATIONS
Key to acquisition of good quality data is the ability to transmit electrical current into the subsurface – this requires insertion of multiple small steel electrodes a few centimetres into the ground. Areas of hardstanding may not be suitable for survey or may require drilling or breaking out prior to survey.

Depth penetration is largely a function of survey line length, typically a line length 5-6 times the target depth is normally required; physical site dimensions may therefore prove restrictive. The equipment is hand portable, however good access is required to allow safe and efficient deployment of cables.