Magnetotellurics: past, present and future

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The magnetotelluric method has been described over 70 years, but has gained significantly in popularity in the last decade. Of the approximately 4000 papers published using MT, almost half of these are from the last decade. There are two primary drivers for this change. Firstly, hardware and software have scaled up, such that >1000 site surveys are common, and massive 3D inversions tractable. Secondly, there has been a demand for deep-imaging, low-impact and relatively cheap resource exploration technologies in many diverse sectors.

Across Australia, from the 1970s-2000 the main approaches were large-scale grids using just the geomagnetic depth sounding (GDS) method to map regional-scale resistivity changes, and high-frequency MT for deposit scale exploration. After 2000, a number of transect MT profiles were additionally collected, often along reflection seismic lines to image crustal boundaries. In the last decade, the focus has shifted more to arrays, particularly with the start of the 55 km spaced AusLAMP long-period MT continental array in 2013, and various smaller broadband MT grids to resolve features from the AusLAMP array.

So what will be the trends for the next decade? As a personal reflection, the areas I see developing are:

- Cheaper instrumentation to increase a site density and data redundancy;
- Satellite inter-connected magnetic and electric field sensors (not necessarily co-located) for real-time data analytics;
- Co-deployment of MT and other geophysical sensors, particularly passive seismics and maybe also heat flow probes;
- Improved MT response estimation methods, particularly in areas of high-cultural noise;
- Rapid and approximate 2D and 3D inversions methods;
- Model analytics in terms of model uncertainty and inference;
- Incorporation of hard and soft model constraints from other geophysical and geological data; and
- Better geological interpretation of the geochemical, thermal and fluid-fluxes that have produced changes in resistivity to engage a wider non-geophysical audience.