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# Recent results from a continuous wave stepped frequency GPR system using a new ground-coupled multi-element antenna array

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The recent availability of multi-channel GPR instrumentation has allowed high-speed acquisition of densely sampled data sets over unprecedented areas of coverage. Such instrumentation has been of particular interest for the mapping of near-surface archaeological remains where the ability to collect GPR data at very close sample spacings (<0.1m) can provide a unique insight to both image and assess the survival of historic assets at a landscape scale. This paper reviews initial results obtained with a 3d-Radar GeoScope MkIV continuous wave stepped frequency (CWSF) GPR system utilising both initial prototypes and production versions of a newly introduced ground coupled antenna array. Whilst this system originally utilised an air-coupled antenna array there remained some debate over the suitability of an air-coupled antenna for all site conditions, particularly where a conductive surface layer, typical of many archaeological sites in the UK, may impede the transfer of energy into the ground.

Encouraging results obtained from an initial prototype ground-coupled antenna array led to the introduction of a full width 22 channel G1922 version in March 2014 for use with the MkIV GeoScope console, offering faster acquisition across a wider frequency bandwidth (60MHz to 3GHz) with a cross-line 0.075m spacing between the individual elements in the array. Field tests over the Roman remains at Silchester corroborated the results from the earlier prototype, demonstrating an increased depth of penetration at the site compared to the previous air-coupled array.

Further field tests were conducted with the G1922 over a range of sites, including Roman villa sites, formal post-medieval garden remains and a medieval farmstead to assess the response of the ground-coupled antenna to more challenging site conditions, particularly through water saturated soils. A full production DXG1820 version of the antenna became available for field work in 2015 offering optimisation of the individual element design to aid the recovery of weak return signals. Again, this has proved useful over sites where the presence of water saturated soils may have compromised the use of an air-coupled antenna array, or potentially restricted the depth of signal penetration.

Collecting densely samples GPR data over very large areas has, however, also produced additional challenges regarding data processing, particularly for assessing acquisition quality in the field, and the interpretation of the resulting results. Some consideration of these aspects will also be covered in the presentation.