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Conductivity-Depth Inversion of Large Loop Transient Electromagnetic Sounding Data over Layered Earth Models

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Abstract : One of the common geophysical techniques for mapping subsurface geo-electrical structures, extensive hydro-geological research, and engineering and environmental geophysics applications is the use of time domain electromagnetic (TDEM)/transient electromagnetic (TEM) soundings. A large transmitter loop for energising the ground and a small receiver loop or magnetometer for recording the transient voltage or magnetic field in the air or on the surface of the earth, with the receiver at the center of the loop or at any random point inside or outside the source loop, make up a large loop TEM system. In general, one can acquire data using one of the configurations with a large loop source, namely, with the receiver at the center point of the loop (central loop method), at an arbitrary in-loop point (in-loop method), coincident with the transmitter loop (coincidence-loop method), and at an arbitrary offset loop point (offset-loop method), respectively. Because of the mathematical simplicity associated with the expressions of EM fields, as compared to the in-loop and offset-loop systems, the central loop system (for ground surveys) and coincident loop system (for ground as well as airborne surveys) have been developed and used extensively for the exploration of mineral and geothermal resources, for mapping contaminated groundwater caused by hazardous waste and thickness of permafrost layer. Because a proper analytical expression for the TEM response over the layered earth model for the large loop TEM system does not exist, the forward problem used in this inversion scheme is first formulated in the frequency domain and then it is transformed in the time domain using Fourier cosine or sine transforms. Using the EMLCLLER algorithm, the forward computation is initially carried out in the frequency domain. As a result, the EMLCLLER modified the forward calculation scheme in NLSTCI to compute frequency domain answers before converting them to the time domain using Fourier Cosine and/or Sine transforms.

Keywords : time domain electromagnetic (TDEM), TEM system, geoelectrical sounding structure, Fourier cosine
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