## ABSTRACT

In this thesis an alternative approach for inversion of one dimensional resistivity sounding data has been suggested. The theoretical background of this approach is based on the theories of depth investigation characteristics (DIC) and resistivity signal partition (RSP). From the derived expressions of RSPs for an N-layered earth the weighting functions (WF) are computed. It has been shown that the expression for apparent resistivity for an N-layered earth can be written as

$$\rho_a = \rho_1 W_1 + \rho_2 W_2 + \ldots\ldots + \rho_N W_N$$

where $W_1$, $W_2$, ......, $W_N$ are the weighting functions for different layeres. WF is defined as the relative weightage a particular layer offers towards the total apparent resistivity for a particular electrode separation. The sum of the WFs has been shown analytically to be unity for simpler earth models (2 & 3-layers). For relatively complicated earth models the sum of the WFs are computed for different electrode separation and observed to be unity or very close to unity.

Starting from the Stefanescu's integral for an N-layered earth the generalised expressions for (i) potential, (ii) depth investigation characteristics, (iii) resistivity signal partitions, (iv) weighting functions, in different media are computed. The quasi-linear relation as given above is obtained. The shapes of WFs curves for different models are computed for better depiction of the anatomy of the apparent resistivity curve WFs are functions of all the parameters namely resistivity and

thickness of all the layers as well as electrode separation. WF curves show (i) the range of electrode separation within which a particular layer contributes towards the total apparent resistivity, (ii) for a thick conductive middle layer in a three layer H-type section, the minimum apparent resistivity will be equal to the true resistivity of the second layer.

An alternative two-tier resistivity inversion (WGRINV) has been proposed in which resistivities and thicknesses are modified in successive steps. The algorithm for inversion using this approach was developed simultaneously with that of the procedure based on the principle of linearising the non-linear Stefanescu's integral (RDGREG). The general performance of both the algorithms are compared and the results are presented in Chapter-IV. The detailed data analysis shows that both the algorithms have their respective domains for better performance. RDGREG, within a certain area of its initial choice, can invert back ~~to~~ the correct parameters. ~~whereas~~ This area for WGRINV is much greater. While dealing with 5 to 6-layer noisy field data, the performance of WGRINV is found to be reasonably better than that of RDGREG. The dependents of the nature of convergence of various parameters namely the first electrode separation value, number of sample points, initial choice are tested. For better initial choices, it (WGRINV) can produce accurate layer parameters whereas for relatively bad a priori assumption i.e. when the layer parameters chosen are two, three or four times the actual values, one can only seek the reasonably good estimate of transverse resistance and longitudinal conductance. Since, in its present state of development, the WGRINV is based on the computational procedure suggested by Mooney et al. (1966), the computation time is much larger in comparison to that for RDGREG which is based on filter theory.

Two more theoretical problems are also presented in Chapters VI and VII. These problems are (i) telluric fields and their gradients overa step fault and (ii) some remarks on normal and lateral log interpretation. The first problem is based on the principle of Schwartz-Christoffel method of conformal transformation for two dimensional potential problems. The telluric fields and their gradients at right angle to their strike direction are computed. The second problem is based on the principles of electrical images. Based on the boundary conditions the two electrode normal and three electrode lateral log curves are computed. From the computed apparent resistivity logs some procedural details for better interpretation are formulated.