GS543 (Tutorial 7)

Assignment-Write a Fortran program to compute apparent resistivity for schlumberger array for N-layer resistivity model using subroutine program.

Note: Name of the subroutine program will be: DCyourfirstname

Theory- First, for a particular value of electrode separation 's_i, $i=1,ns$ (s is half of current electrode separation), determine Resistivity transform $T_1(\lambda_j)$, $j=1, M$ using the relation (M number of filter coefficients) $\lambda_j = 10^{(a_j - log_{10} s_i)}$ where a_j are the base10 abscissa values of filter coefficients in given table below.

The resistivity transform for a N layer case for a particular value of λ_j is given by the recurrence relation

$$T_{k-1}(\lambda_j) = \frac{T_k + \rho_{k-1} \tanh(\lambda_j h_{k-1})}{1 + \frac{T_k \tanh(\lambda_j h_{k-1})}{\rho_{k-1}}}$$

$k=N,N-1,\ldots\ldots.2$. ρ_k and h_k are resistivity and thickness of k^{th} layers. Resistivity transform $T_N=\rho_N$

The Schlumberger apparent resistivity is then given by

$$\rho_a(s_i) = \sum_{j=1}^{M} f_j \, T_1(\lambda_j)$$

f_j, $j=1$, M are filter coefficients.

Table: Nineteen point filter

	Abscissa of filter coefficients (a_j)	Filter coefficients (f_j)
1	-0.980685	0.00097112
2	-0.771995	-0.00102152
3	-0.563305	0.00906965
4	-0.354615	0.01404316
5	-0.145925	0.09012
6	0.062765	0.30171582
7	0.271455	0.99627084
8	0.480145	1.3690832
9	0.688835	-2.99681171
10	0.897525	1.65463068
11	1.106215	-0.59399277
12	1.314905	0.22329813
13	1.523595	-0.10119309
14	1.732285	0.05186135
15	1.940975	-0.02748647
16	2.149665	0.01384932
17	2.358355	-0.00599074
18	2.567045	0.00190463
19	2.775735	-0.0003216

Flowchart-

Start

Read ns (ns is number of spacing or AB/2 values)

Read s_i, *i=1, ns* (s-half of current electrode separation)

Read, number of layers (*N*), their resistivity (*N* values) and thickness (*N-1* values)

Read a_j, f_j , j=1, *M* (*M* is number of number of filter coefficients)

Loop over s_i, *i=1,ns*

Loop over a_j, *j=1 to 19*

Compute $\lambda_j = 10^{(a_j - log_{10} s_i)}$

For each λ_j compute resistivity transform $T_1(\lambda_j)$ and keep in memory

(Start from $T_N = \rho_N$ and evaluate till T_1, *N* is number of layers)

End Loop over a_j

Compute $\rho_a(s_i) = \sum_{j=1}^{M} f_j \, T_1(\lambda_j)$

Save s_i verses $\rho_a(s_i)$

End loop over s_i

stop

Use

s=1.5, 2, 3, 4, 6, 8, 10, 15, 20, 25, 30, 40, 50, 60, 80, 100, 120, 140, 160, 180, 200, 250, 300, 350, 400, 500, 600, 800, 1000. m

Plot s verses ρ_a on log-log scale.