Exercise 3
The inversion of Vertical Electrical Soundings with spatial constraints

During a field campaign five vertical electrical soundings (VES) were collected at different locations. The collected data is presented in the files VES1, VES2, VES3, VES4, and VES5. A matlab routine has been implemented for the inversion of the VES data using the approach described by Yunus et al. (2008)[1], such approach permits to define the number of possible layers to improve the inversion results. In our case the number of layers can be defined using a graphical interface to account for (1) the number of inflection points (typically used to estimate the number of layers), (2) to account for existing information of the study area.

The files VES1, to VES5 are given by 4 columns:

1) Half-separation between current electrodes ($\frac{AB}{2}$), as illustrated in Figure 1
2) Half-separation between potential electrodes ($\frac{MN}{2}$),as illustrated in Figure 1
3) Injected current (Ampere)
4) Measured voltage (Volts)

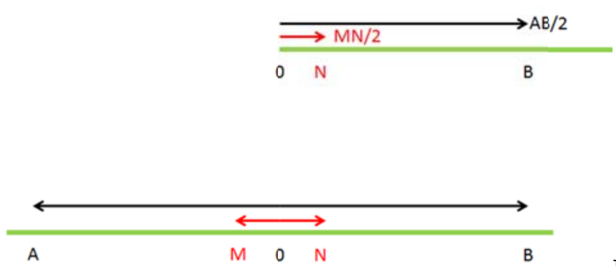

Figure 1: schematic representation of the Schulmberger array used for the collection of VES data.

The matlab routine will automatically read the input file, which should be given in terms of a text file with 2 columns:

Column 1: half the separation between current electrodes ($\frac{AB}{2}$) in meters

Column 2: the apparent resistivity for each measurement in ohm m (Ωm). Remember that the apparent resistivity is the product of the resistance times the geometric factor.

The objective of this exercise is to provide a general description of the study area. For this the following steps are required:

1) Please for each VES, write the correct file for the inversion, for this you need to read the provided VES#.txt file, compute the geometrical factor for each reading and obtain

---

[1] Yunus, L.E., and Alper, D., 2008. A Damped Least-Squares Inversion Program for the Interpretation of Schlumberger Sounding Curves. Journal of Applied Sciences, 8: 4070-4078.

the corresponding apparent electrical resistivity. Afterwards, you can write a VES#.dat file with the correct format for the inversion (AB/2, apparent resistivity).

2) Please note that the equation for the geometric factor is given in terms of the separation between current electrodes (A and B) and potential electrodes (M and N). Note that in case of this exercise, the information is given by AB/2 and MN/2, please provide the modified equation used for the computation of the geometric factor.
3) Using the routine VES1Dinv, please perform the inversion of each one of the 5 VES files. To better understand the difference in the inversion please follow the following steps
    a. For each VES file select only 2 points one close to the first measurement and one close to the last one. Please write the thickness and electrical resistivity for each layer as obtained after the inversion for each VES file.
    b. For each VES select so many points as inflection points found in the curves. Inflection points are those associated with the change in the direction of the curves. Please write the thickness and electrical resistivity for each layer as obtained after the inversion for each VES file.
    c. Compare the results obtained between steps 3a and 3b
    d. Please define your own model for setting the constraints, for instances you can define more constraints than inflection points – or even more than existing measurements (for instances 5 or 10 constraints – or mouse clicks), or use the same constraints for all VES as defined for one of the datasets.
    e. Compare the results between steps 3b and 3d
4) Please comment on the inversion of VES data: for instances, do the inverted models depend strongly or weakly on the number of constraints?
5) Could you please describe the main differences between the inverted models? – are the inverted models consistent for the 5 different VES – i.e., do they show the same distribution of layers?

Delivery date: November 25, 2016 at latest 10:00 am (tugeophysics@outlook.com)