**SIO 182 Assignment 6.** Given 18 Feb, due 25 Feb.

1) The notes describe T-equivalence, S-equivalence, and suppression in resistivity sounding. We can demonstrate these using the Matlab function `Sfilt`, which executes the Schlumberger resistivity forward response of a layered earth structure. Download the Matlab routine **SFilt.m** from the website. The usage is

```
rho = SFilt(AB, thick, res)
```

where `AB` is an array of electrode spacings, `thick` is an array of thicknesses, and `res` is an array of resistivities. The thicknesses and resistivities start from the top, and there should be one more resistivity than thickness, because the last layer always has an infinite thickness.

The electrode spacing is normally exponential, so we fill up an array of spacings using the `logspace()` function:

```
AB = logspace (0,4,50);
```

which will generate 50 electrode spacings between 1 m and 10 km (use the Matlab help command to see `logspace` syntax).

So, to generate and plot a T-type 3-layer resistivity curve, execute

```
thick = [10,1];
res = [10,1000,5];
rho = SFilt(AB,thick,res);loglog(AB,rho,'r');
```

or execute the command directly using

```
rho = sfilt(AB,[10,1],[10,1000,5]);loglog(AB,rho,'r');
```

`hold on` the plot and observe the equivalence when the thickness of the second layer is doubled and the resistivity halved:

```
rho = SFilt(AB,[10,2],[10,500,5]);loglog(AB,rho,'y');
```

Find out how thick the second layer must be before the resistivity and thickness can be resolved independently while keeping T the same. (Not just a line's width different, but resolved with realistic field data, with, say, 5% errors.) Release the plot and generate an S-type 3-layer curve:

```
rho = SFilt(AB,[10,1],[100,1,50]);loglog(AB,rho,'r');
```

Hold the plot again and generate an S-equivalent curve;

```
rho = SFilt(AB,[10,2],[100,??,50]);loglog(AB,rho,'y');
```

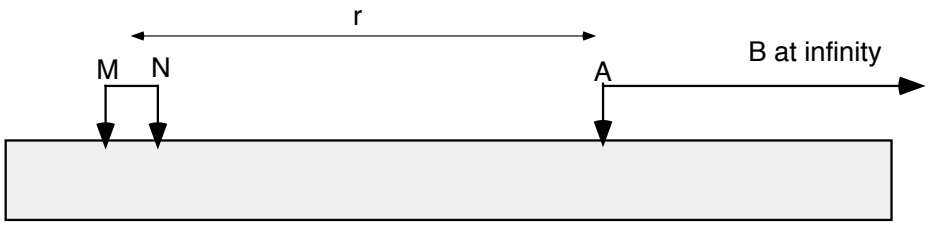
What number should replace the '??' ? How thick must the layer get before the resistivity and thickness are resolved independently while keeping S constant? Note how the resistivity curves can drop much more rapidly than they can rise. Finally, demonstrate suppression by executing

```
rho = SFilt(AB,[10],[10,1000]);loglog(AB,rho,'m');
hold on;
rho = SFilt(AB,[10,1],[10,100,1000]);loglog(AB,rho,'r');
```

How thick must the second layer become before it can be resolved? Include a copy of all your plots in the assignment.

2) In a Wenner array, I have a 24 V source of electricity for the transmitter (AB) current. I measure 120 Ohm in the AB circuit. How much current will flow through the ground? My array has $a$ = 10 m, and I measure a $\Delta$V of 200 mV. What is the apparent resistivity of the ground?

3) Derive an expression for the apparent resistivity of a co-linear 'pole-dipole' array in terms of $r$ and $MN$:




What would be the effect of rotating the MN array by 90° (that is, MNA would no longer be co-linear, but form a 'T')?