Knud Valdemar T. Lassen

Geophysicist

AGS Aarhus GeoSoftware

Program

- Short walkthrough of different types of 3D and pseudo 3D datasets
- How to combine 2D datasets into 3D datasets using Res2DInv
- Pitfalls when combining 2D datasets into 3D datasets
- Interpolating 2D inversions into 3D models

Litterature:

Dr. M.H. Loke, Tutorial : 2-D and 3-D electrical imaging surveys

Especially chapter 8: 3-D electrical imaging surveys

http://www.ags-cloud.dk/Wiki/W_GeotomoNotes

Different types of 3D datasets

The “ideal” 3D dataset:

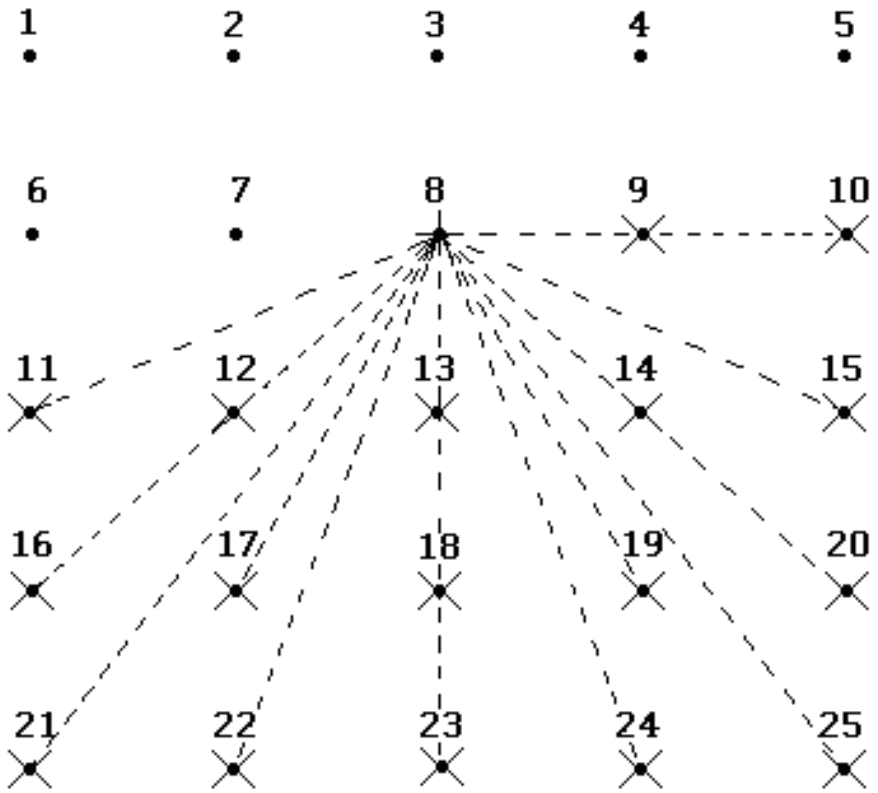
- Electrodes are laid out in a more ore less structured grid
- Measurements are made in all directions, along the grid lines and at different angles to these

Pros:

- Covers all possible current paths in the ground
- Ideal resolution of 3D structures

Cons:

- Very expensive in both time and equipment



Different types of 3D datasets

The “best we can do with 2D instruments” 3D dataset:

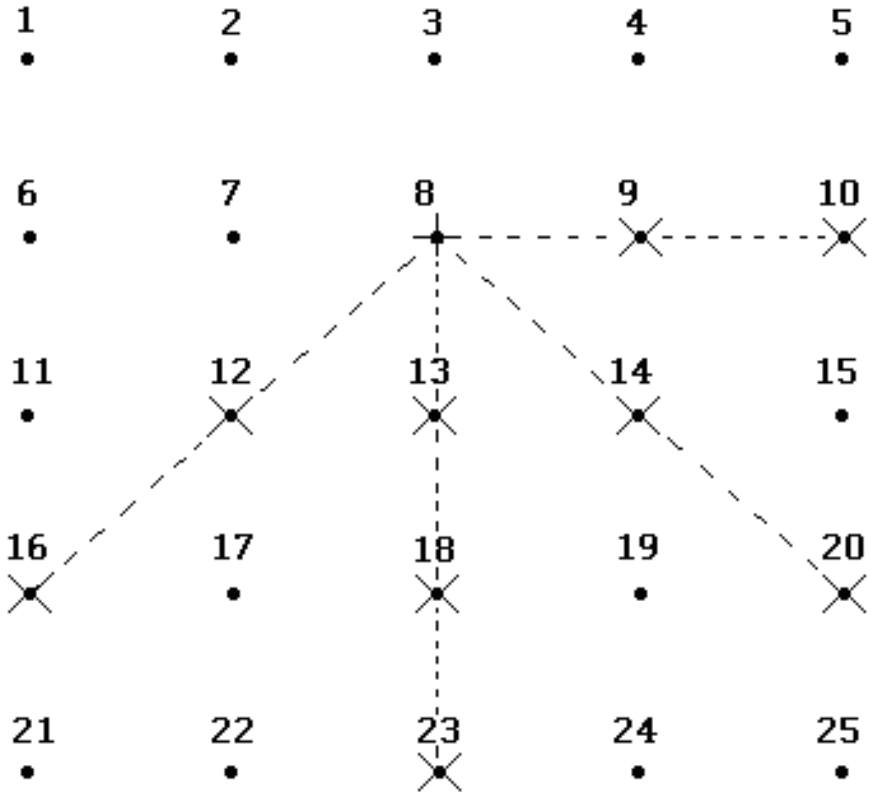
- Electrodes are laid out in a more ore less structured grid
- Measurements are made in all directions, along the grid lines and at different angles to these

Pros:

- Nearly as good as the ideal dataset
- Can be carried out with “standard” 2D equipment

Cons:

- Possibly even more time consuming than the ideal 3D survey



Different types of 3D datasets

The “realistic with 2D equipment” 3D dataset:

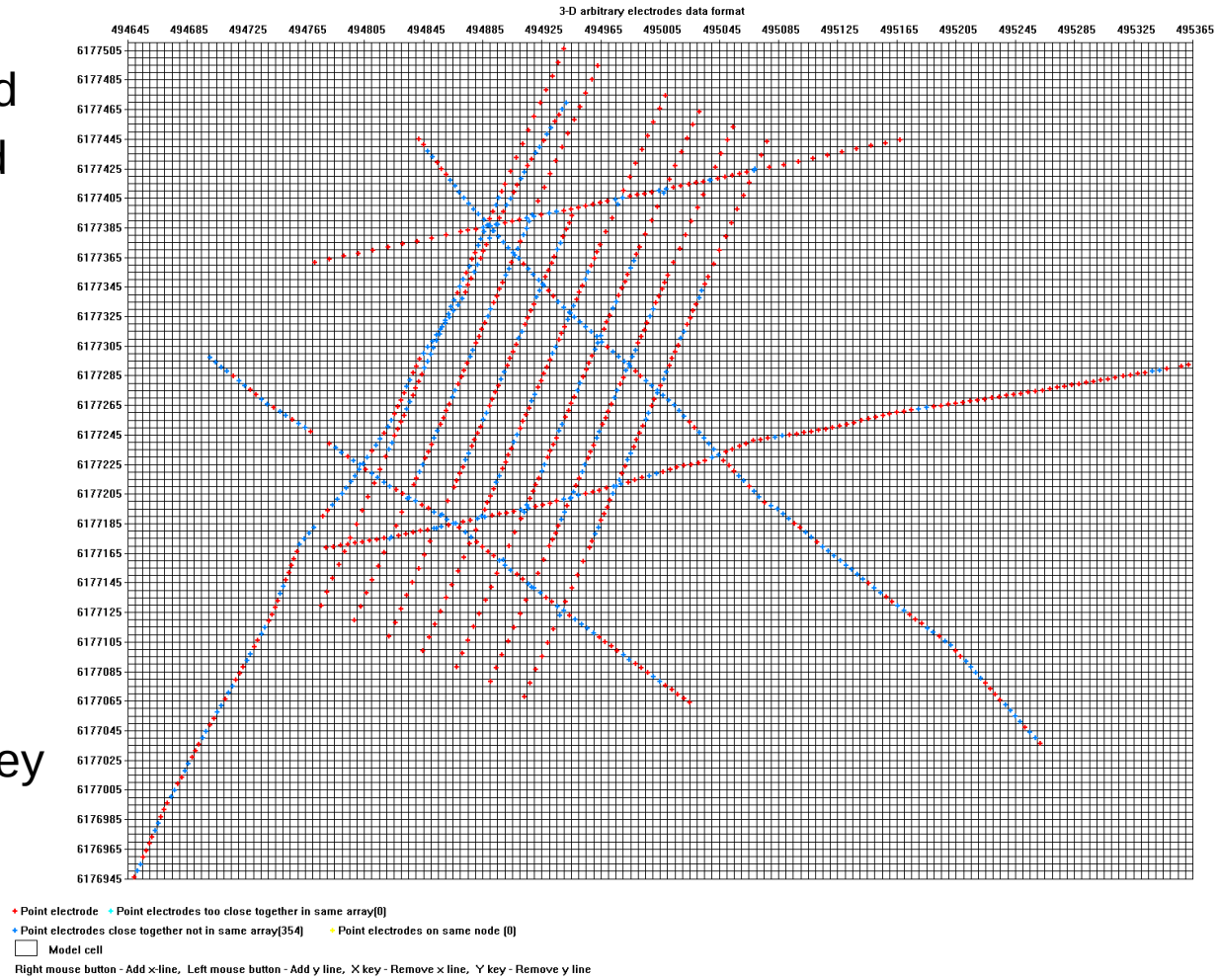
- Electrodes are laid out in a more ore less structured grid
- Measurements are made in all directions, along the grid lines and at different angles to these

Pros:

- Decent 3D information in the dataset
- Can be carried out with “standard” 2D equipment
- Good trade-off between resolution and price

Cons:

- Still much more time consuming than a regular 2D survey
- Does not provide full 3D coverage



What makes a good 3D from 2D dataset?

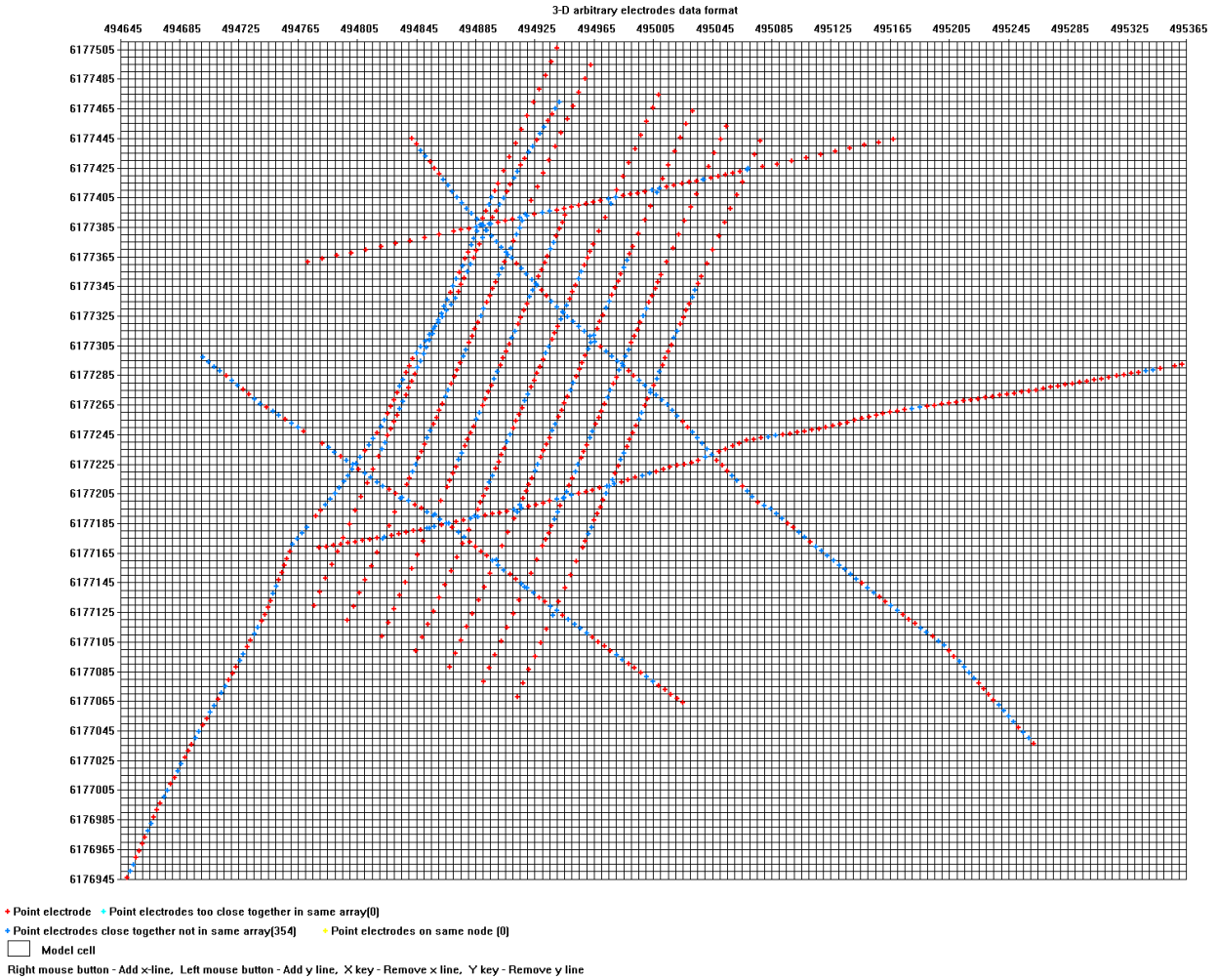
AGS Aarhus GeoSoftware

Low distance between the 2D lines

- Ideally the same spacing as the minimal electrode spacing
- Up to 2-3 times is usually accepted (also depending on the presence of tie lines)

Lines in several directions:

- Ideally the lines should cover the survey area in many different directions
- Usually a measurements are made in a grid like structure with survey lines being perpendicular to each other
- Often we only have parallel 2D lines with no or a few tie lines

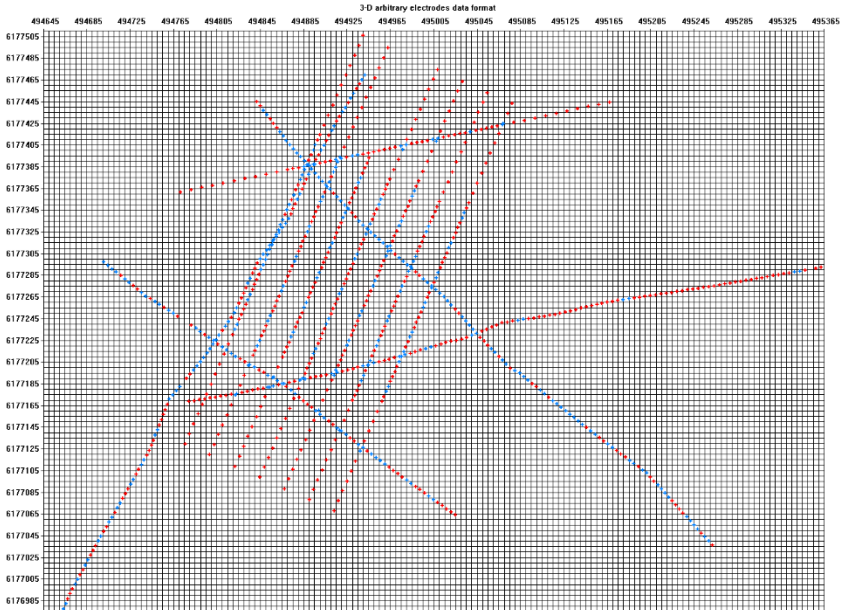


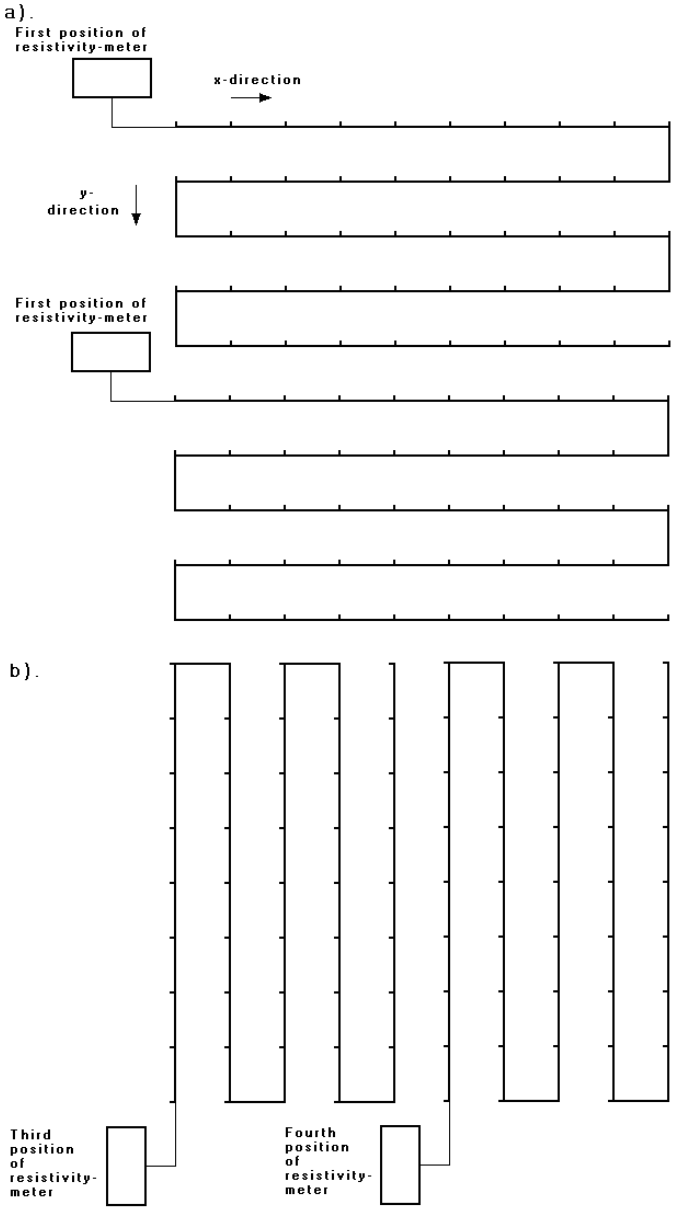
How to combine the 2D surveys to 3D

- Prepare the 2D dat files in the same way as for a regular 2D inversion
- Combine the files using Res2DInv, this is done by preparing a text file

Two options

1. Add global coordinates and use these to position the lines
2. Define the relative positions of the 2D lines in the collation text file (only for parallel and perpendicular lines)





How to combine the 2D surveys to 3D
Option 1, adding global coordinates

```
4        235.00        4.82       355.00        7.41       305.00        8.33       315.00        8.44     138.0700
4        235.00        4.82       355.00        7.41       315.00        8.44       325.00        8.28     134.3600
4        235.00        4.82       355.00        7.41       325.00        8.28       335.00        8.00     138.9900
4        235.00        4.82       355.00        7.41       335.00        8.00       345.00        7.72     138.6200
0
Global Coordinates present
Number of coordinate points
17
Local Longitude Latitude
   85.00     572088.12    6222426.57
   90.00     572088.28    6222421.58
  110.00     572088.91    6222401.60
  115.00     572089.07    6222396.61
  120.00     572089.23    6222391.62
  125.00     572089.39    6222386.66
  160.00     572090.50    6222351.66
  165.00     572090.66    6222346.67
  170.00     572090.82    6222341.68
  175.00     572090.98    6222336.68
  200.00     572091.77    6222311.72
  205.00     572091.93    6222306.74
  250.00     572093.36    6222261.85
  255.00     572093.52    6222256.88
  260.00     572093.67    6222251.91
  325.00     572098.11    6222187.28
  355.00     572100.26    6222157.44
0
```

Last 4 data lines, or topography section

Header lines

Number of corrdinate points

Header line

X-coordinate along profile, Longitude/UTMX, Latitude/UTMY

End of file

How to combine the 2D surveys to 3D
Option 1, recommended

AGS Aarhus GeoSoftware

```
3-D arbitrary electrodes data format
Number of files to collate
12
Arbitrary point electrodes format
X model grid spacing
5.0
Y model grid spacing
5.0
File 1 parameters
Name of data file in RES2DINV format
C:\Users\KVTL\Dropbox (Aarhus GeoSoftware)\KV\Webinar\2Dto3D\Example\Profile_1_2D.dat
File 2 parameters
Name of data file in RES2DINV format
C:\Users\KVTL\Dropbox (Aarhus GeoSoftware)\KV\Webinar\2Dto3D\Example\Profile_2_2D.dat
File 3 parameters
Name of data file in RES2DINV format
C:\Users\KVTL\Dropbox (Aarhus GeoSoftware)\KV\Webinar\2Dto3D\Example\Profile_3_2D.dat
Name of Output file in RES3DINV format
C:\Users\KVTL\Dropbox (Aarhus GeoSoftware)\KV\Webinar\2Dto3D\Example\Combined3D.dat
End of file
```

How to combine the 2D surveys to 3D

Option 2

```
Collate 3 Lines
Number of files to collate
3
File 1 parameters
Name of data file in RES2DINV format
d:\test\FILE2D_1.DAT
X and Y location of first electrode along this line
0.0,0.0
Line direction (0=X,1=Y)
0
Line sign (0=positive,1=negative)
0
File 2 parameters
Name of data file in RES2DINV format
d:\test\FILE2D_2.DAT
X and Y location of first electrode along this line
0.0,-0.5
Line direction (0=X,1=Y)
0
Line sign (0=positive,1=negative)
0
File 3 parameters
Name of data file in RES2DINV format
d:\test\FILE2D_3.DAT
X and Y location of first electrode along this line
0.0,-1.0
Line direction (0=X,1=Y)
0
Line sign (0=positive,1=negative)
0
Name of Output file in RES3DINV format
d:\test\FILE_3D.dat
End of file
```

NOTE: With this method the grid discretisation needs to be edited manually

3D interpolation instead of 3D Inversion

- Possible alternative when 3D inversion is not an option
- Most suitable for simple layered geologies

Performing 3D interpolation in Aarhus Workbench Essentials

1. Run the inversions as regular 2D inversions
2. Export the results to VTK files as described here: http://www.ags-cloud.dk/Wiki/W_GeotomoGuides
3. Import the VTK's in Aarhus Workbench Essentials and perform the interpolation