GPRMax Data

Generating Input files and their respective B-scans

Input Commands

Different types of commands in GPRMax:

Essential commands : Required to run any model, such as time window, domain size and spatial discretization.

General Commands : Provide further control over the model. (directories, python script, threads)

Material Commands : Used to introduce different materials into the model. (material, soil peplinski, dispersion)

Object Construction Commands : Used to build geometric shapes with different constitutive parameters. (geometry view, cylinder, fractal box, surface roughness)

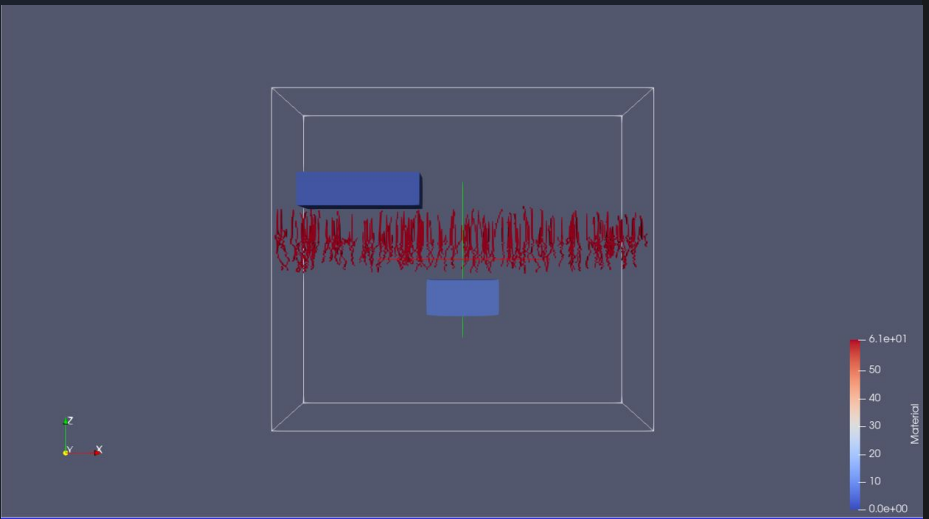
Source and Output Commands : Used to place source and output points in the model. (waveform, voltage source, src steps)

Input File

Visualization :

Mine, transmitter and grass can be seen, else is hidden.

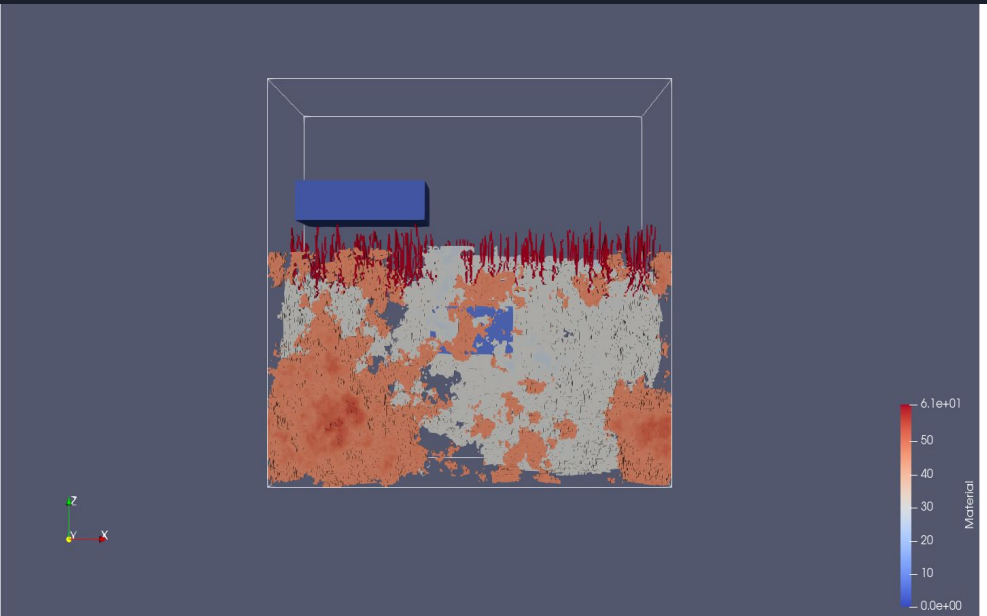
Generated using paraview software.

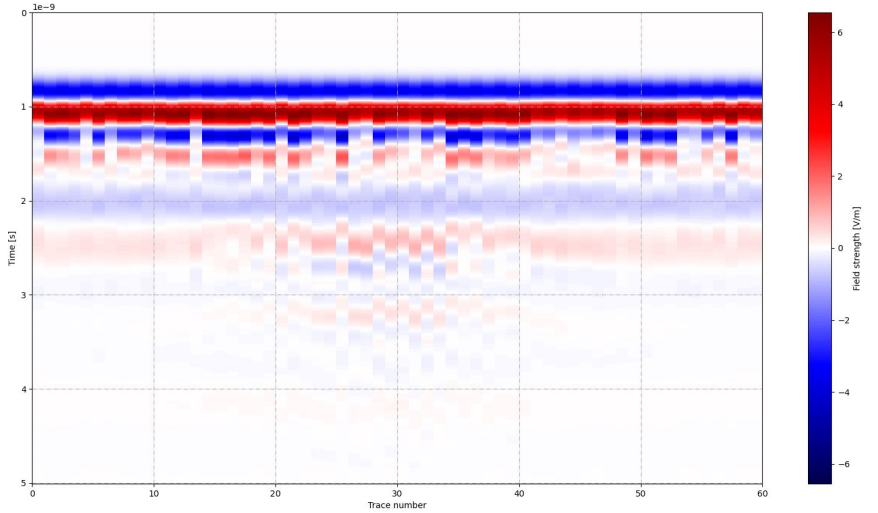



```
#title: mine1
#domain: 0.5 0.25 0.45
#dx_dy_dz: 0.002 0.002 0.002
#time_window: 5e-9

#python:
from user_libs. antennas. GSSI import antenna_like_GSSI_1500
antenna_like_GSSI_1500(0.1 + current_model_run * 0.005, 0.126,0.30, 0.002)
#end_python:

#soil_peplinski: 0.308 0.692 2.038 2.8 0.0529 0.094 my_soil
#fractal_box: 0 0 0 0.5 0.25 0.25 1.5 1 1 1 50 my_soil my_soil_box
#add_surface_roughness: 0 0 0.25 0.5 0.25 0.25 1.5 1 1 0.235 0.267
my_soil_box

#add_grass: 0  0 0.25 0.5 0.25 0.25 1.5 0.254 0.298 200 my_soil_box

#material: 3.5 0.01 1.0 0 bakelite
#material: 6.0 0.01 1.0 0 rubber
#material: 2.86 0.00048 1.0 9.75 TNT
#material: 2.4 0 1 0 plastic

#cylinder: 0.25 0.126 0.20 0.25 0.126 0.197 0.056 rubber
#cylinder: 0.25 0.126 0.197 0.25 0.126 0.144 0.056 bakelite
#cylinder: 0.25 0.126 0.197 0.25 0.126 0.147 0.053 TNT
#cylinder: 0.25 0.126 0.197 0.25 0.126 0.147 0.002 pec

#geometry_view: 0 0 0 0.5 0.25 0.45  0.002 0.002 0.002  geometry n
```

B-scan

- Visualization of the input file and its respective Bscan plot.
- 60 trace generates low resolution B-scan.





Input Commands

Changing number of objects and analyzing the effects on its B-scan:

Multiple mines/objects case:

Domain Size (1.0 , 0.25 , 0.45)

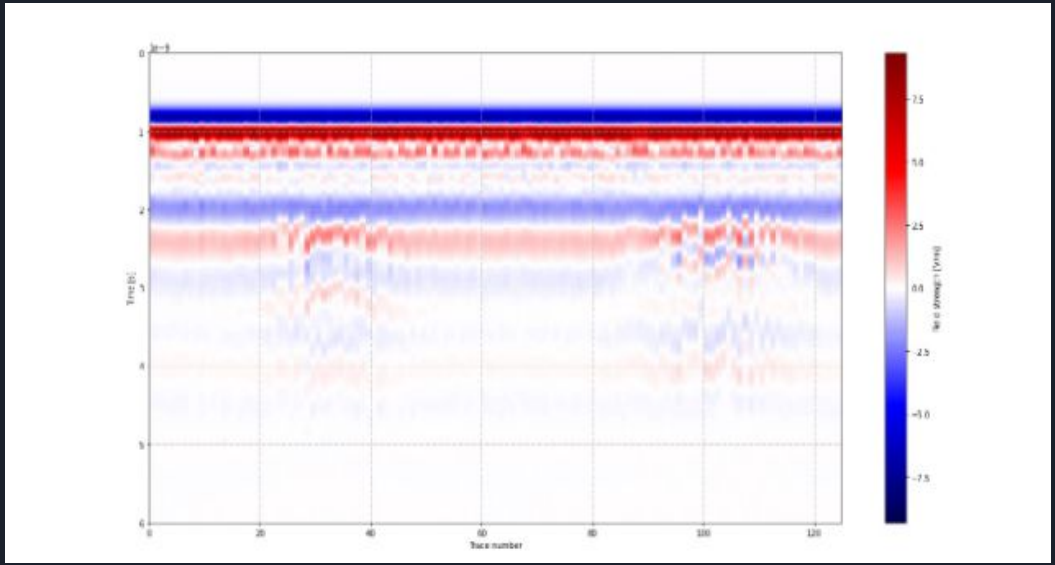
Positions:

Object1: (0.3 , 0.125 , 0.15)

Object2: (0.67 , 0.12 , 0.13)

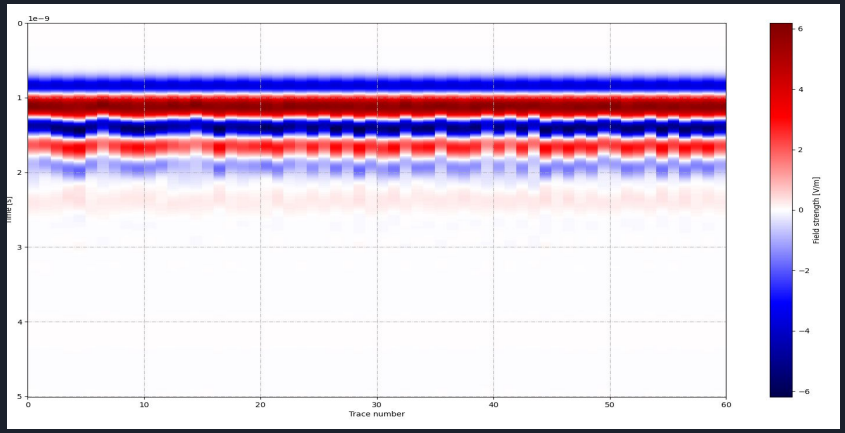
120 traces generates better resolution B-scan

Input File

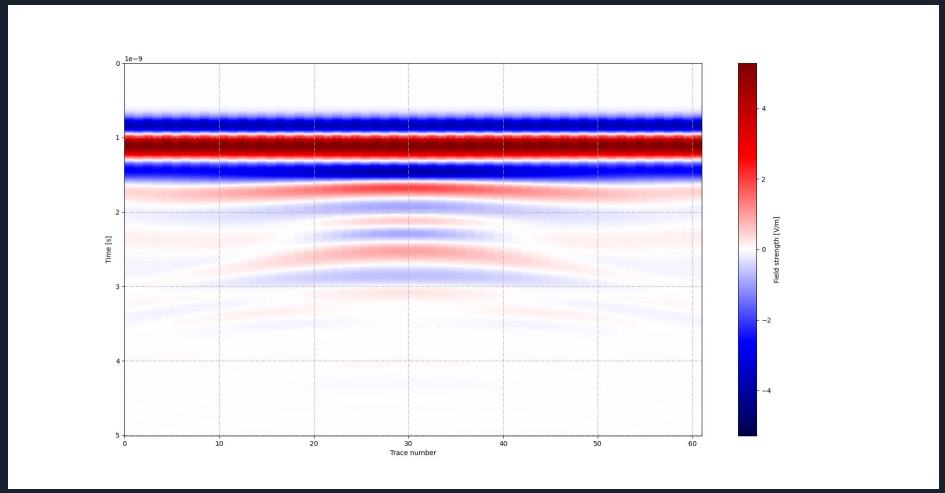


Input Commands

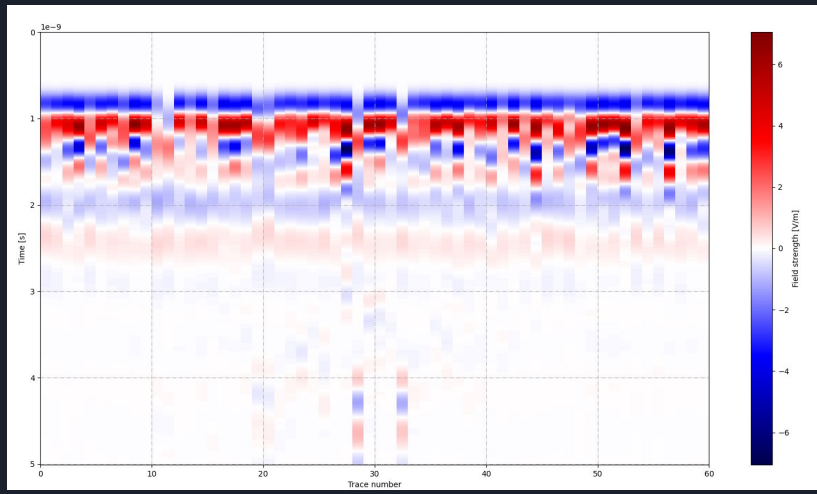
Different B-scans are generated with different input commands like no mine, mine in soil and mine in free space. We can see how point objects like mine can generate a hyperbola in B-scan and how no soil B-scan looks smooth as there are no soil particles to scatter the radio waves.



No mine (No hyperbola generated)



Mine (no soil/free space)



Mine (hyperbola generated)

Input Commands

Changing domain discretization and analyzing the effects on its B-scan:

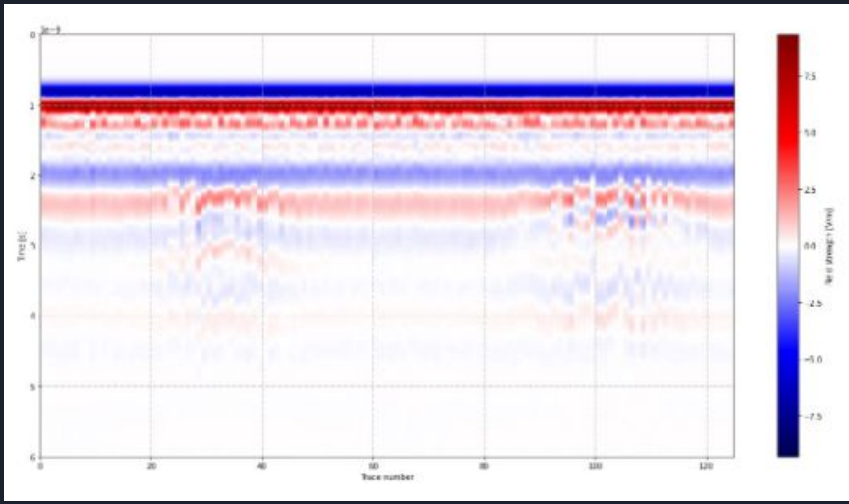
Domain discretization (1mm)

#dx_dy_dz: 0.001 0.001 0.001

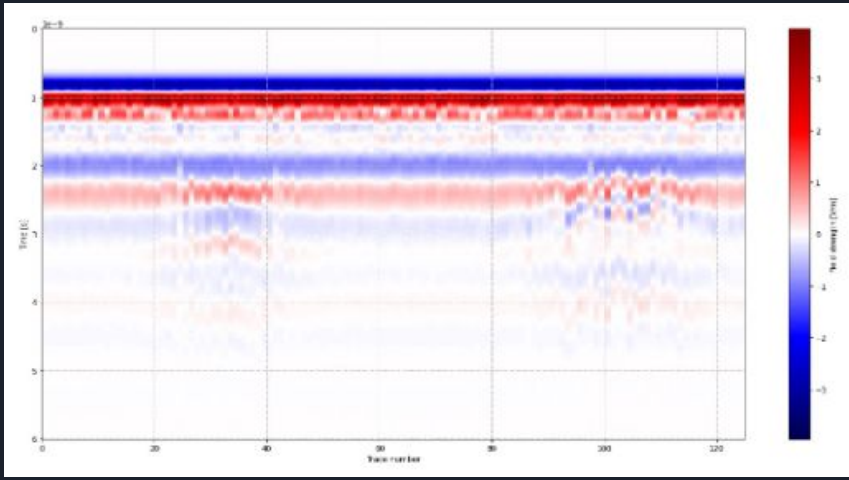
Changing the domain discretization to (2mm)

#dx_dy_dz: 0.002 0.002 0.002

This change has very less effect on the resolution of the scan , so we have considered 2 mm as it needs less computational power.

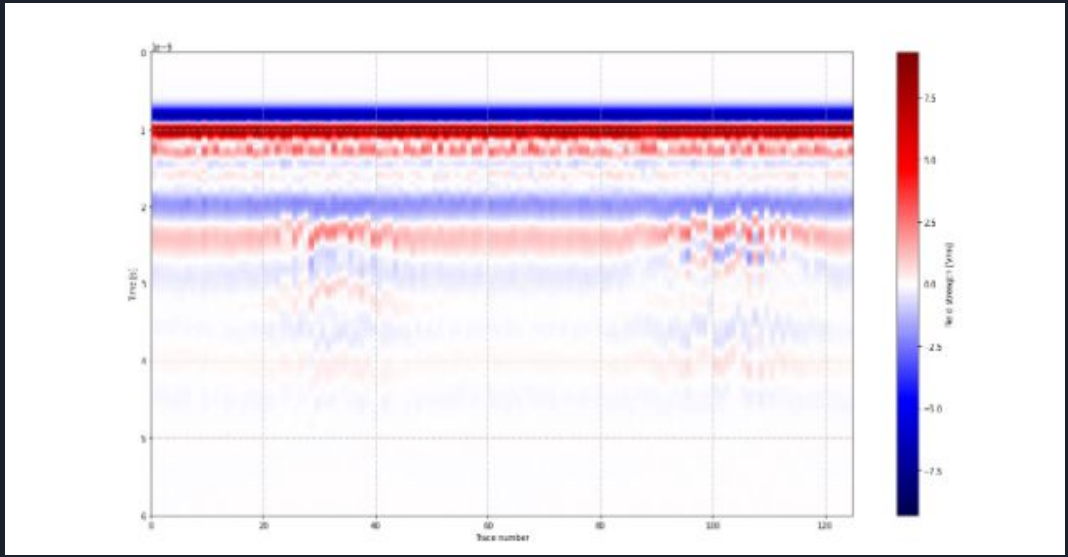


1mm discretization



2mm discretization

Multiple Mines



Two hyperbolas were created when encountered with two mines at different locations.

Different commands

For input file named data1.txt in the destination folder user_models

Ascan generation: python -m gprMax user_models/data1.txt

python -m gprMax user_models/data1.txt -n 100
(For 100 number of A scan generations)

Bscan generation: python -m tools.outputfiles_merge user_models/data1.out

(To merge A scan files generated)

python -m tools.plot_Bscan user_models/data1_merged.out Ey

(Plotting B Scan)

Input for training the model

We generated 15 input files for no mine and 25 input files with mine case by changing the values of soil composition, mine position, grass height and surface roughness.

Further we can use python scripts to generate more input files, run commands and generate further B-scan data for training purpose.

THANK YOU!