# WFTEM3D2.0

A quick, flexible, and extensible 3D TEM modeling open-source software. Supports wire/loop sources, half/whole-space, and ground/airborne/marine/tunnel/borehole scenarios.

## Method

The scheme steps Maxwell’s equations in time using a staggered grid and a modified DuFort-Frankel method: First, wires are modeled as volume currents, and the scheme calculates the primary field based on a whole-space homogeneous model; then it calculates the secondary field using the true model. The relevant paper will be provided in subsequent updates.

## Installation

This software requires no installation—just run it directly.

## Usage

We use the example of ***a conductive brick in a half-space*** to show how to use WFTEM3D2.0.

### 1. Edit the input file according to your model.

***Example_conductive_brick_in_a_half-space.txt*** is the input file of the model ***a conductive brick in a half-space***:

```
##### Comment lines start with #, data is separated by spaces, ',', or ';'.
##### Model description: A 0.1 S/m half-space contains a 2 S/m conductive brick (100 m × 40 m × 30 m)
##### at 30 m depth. Central-loop configuration: 100 m × 100 m.

##### Number of cells in the x-, y-, and z-directions.
27 25 25
##### Grid size in the x direction (m).
2560 1280 640 320 160 80 40 20 10 10 15 10 10 10 15 10 10 10 10 20 40 80 160 320 640 1280 2560
##### Grid size in the y direction (m).
2560 1280 640 320 160 80 40 20 10 10 15 10 10 10 15 10 10 20 40 80 160 320 640 1280 2560
##### Grid size in the z direction (m).
5120 2560 1280 640 320 160 80 40 20 10 5 5 10 15 15 15 20 40 80 160 320 640 1280 2560 5120

##### Tx position:
9 9 11 # (x1, y1, z1).
17 17 11 # (x2, y2, z2).
##### Loop source: Aligns with the outer edge of the cells between (x1, y1, z1) and (x2, y2, z2).
##### Wire source: Aligns with the -x or -y edge of the cells between (x1, y1, z1) and (x2, y2, z2).
```

```
##### Transmitter depth: at the bottom plane of these cells. Current=1 A.
# To display following graphic correctly, please view in monospaced font (e.g.,
Courier New/Lucida Console).
#   +=======+=======+=======+    +-------+-------+-------+   +-------+-------+-------+
#  || x1,y1 |       |       ||   |      || x1,y1 |       |   |       |       |       |
#   +-------+-------+-------+    +-------+-------+-------+   +=======+=======+=======+
#  ||       |       |       ||   |      ||       |       |   | x1,y1 |       | x2,y2 |
#   +-------+-------+-------+    +-------+-------+-------+   +-------+-------+-------+
#  ||       |       | x2,y2 ||   |      || x2,y2 |       |   |       |       |       |
#   +=======+=======+=======+    +-------+-------+-------+   +-------+-------+-------+
#             Loop                    Wire (if x1=x2)             Wire (if y1=y2)

##### Rx position:
13 13 1 # Rx along x-direction: start/end/interval.
13 13 1 # Rx along y-direction: start/end/interval.
11 11 1 # Rx along z-direction: start/end/interval.
##### Receivers are located at the centers of the bottom surfaces of these cells.

##### Iteration numbers of primary field and secondary field.
600 6400
##### Coefficients for calculating time step size of primary field and secondary
field.
0.8 0.8

##### Number of model subdomains.
3
##### Cells range (x=?–?, y=?–?, z=?–?) and conductivity (?) of each subdomain.
1    27    1    25    1    25    0.1 #Cells range (x=1–27, y=1–25, z=1–25) and
conductivity (0.1 S/m) of the background.
1    27    1    25    1    11    0.0003 #Cells range (x=1–27, y=1–25, z=1–11) and
conductivity (0.0003 S/m) of the air.
16    19    9    17    15    16    2 #Cells range (x=16–19, y=9–17, z=15–16) and
conductivity (2 S/m) of the conductive brick.
```

### 2. Run the program.

First, double-click ***WFTEM3D2.0.exe***, then enter the input filename, and press Enter to start the calculation.

### 3. View calculation results.

Results (dBz/dt at every time instants) will be output automatically when the calculation is finished. There are three output files:

- Result_time.txt

The time instants are saved in this file. The example is shown as follows:

```
1.2286042e-08
1.5792647e-08
...
1.0299405e-02
1.0302622e-02
```

The unit of time is s.

- Result_dBz.txt

The dBz/dt at receivers are saved in this file. The example is shown as follows:

```
-1.0170416e-04
-1.0553606e-04
...
-4.7702894e-10
-4.7667189e-10
```

The unit of dBz/dt is V/Am^2.

For multiple receivers, each as a column, the columns are arranged from left to right in the following order: the x-direction varies first, followed by the y-direction, and then the z-direction, e.g., (1,1,1), (2,1,1), (1,2,1), (2,2,1), (1,1,2), (2,1,2), (1,2,2), (2,2,2).

- Run_time.txt

The run time is saved in this file. The example is shown as follows:

```
Computation finished. Run-time is 1.09375000000000 s.
```

## Contributing

Pull requests are welcome. We expect contributions via email with the corresponding author (email: figo1@163.com).