H2DTOMO: a C++ package for 2-D joint refraction and reflection travel-time tomography

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1. Startup file

Default startup filename: “Startup_Tomography”

File format:

```
TRAVELTIME MODE: 2  -0:only refl  1:only refr  2:both
FORWARD OR INVERSION: INVERSION
FORWARD SETTING FILE: ./Settings/Tomo2D/FsmSettings
INVERSION SETTING FILE: ./Settings/Tomo2D/InvSettings
MESH STEEING FILE: ./Settings/Tomo2D/MeshSettings_cx
OBSERVED DATA FILE: ./Data/TomoData/data_cx574
```

FORWARD OR INVERSION: you can choose “forward” or “inversion”

Three setting file are necessary : forward, inversion and mesh setting file

One observed data file id needed

2. Data file

File format:

```
nshot          -number of shot
s   x   z   nrec      - flag ”s”, source coordinate (x , z), and number of receivers
r   x   z   raycode   time   dt   - flag ’r’, rcv’s coordinate (x , z),
                                   raycode (0:refraction, 1:reflection),
                                   traveltime in second,
                                   and pick error in second
```

x and z are all kilometer!

If the z>0, it means under the SEA LEVEL! If the data is observed on land, z should be

minus.

%Data example%

574

s 58.554 -0.0764163 299

r 55.56 -0.0924 0 0.744376 0.005

r 55.5805 -0.0925 0 0.739635 0.005

r 55.6001 -0.0925 0 0.734719 0.005

r 55.6203 -0.0925 0 0.736789 0.005

r 55.6402 -0.0913 0 0.728497 0.005

r 55.6606 -0.0912 0 0.725862 0.005

r 55.68 -0.0916 0 0.724438 0.005

r 55.7002 -0.0906 0 0.719015 0.005

r 55.7205 -0.0902 0 0.706349 0.005

r 55.7406 -0.0879 0 0.703477 0.005

r 55.7608 -0.0872 0 0.710317 0.005

r 55.7795 -0.0868 0 0.699597 0.005

r 55.8071 -0.0892 0 0.720955 0.005

r 55.8245 -0.088 0 0.710297 0.005

r 55.8388 -0.088 0 0.703259 0.005

r 55.8572 -0.0878 0 0.68608 0.005

r 55.88 -0.0851 0 0.702351 0.005

r 55.9 -0.0847 0 0.681986 0.005

r 55.9201 -0.0852 0 0.675835 0.005

r 55.9405 -0.0851 0 0.676458 0.005

r 55.9603 -0.0869 0 0.678044 0.005

3. MeshSetting file

File format:

```
MESH TYPE: LAND          - land or marine
NX NY: 800 60            - Number x-center and y-center
UNIFORM GRID: YES        - yes or no
DX DY(km): 0.05 0.05     - interval x and y, in km!
GRID FILE: ./Settings/Tomo2D/grid.dat     - grid file, only if uniform grid is "no"
TOPOGRAPHY FILE: ./Settings/Tomo2D/topo.dat     -topo file
XSTART YSTART: 55 0      - start location in km
MODEL TYPE: gradient0    -gradient0 or gradient1(auto mesh) or file(through file)
VELOCITY FILETYPE: binary    -binary or ascii, only needed if model type = "file"
VELOCITY FILE: ./Settings/Tomo2D/init_mod_v.dat    - init_mod file name
V_START DV(km/s): 3 0.08    - auto mesh velocity, if model type = "gradient*"
INTERFACE FILE: ./Settings/Tomo2D/Interface.dat -interface file
```

All the parameter is in kilometer!

Topo file can be uneven and the program will interpolate it automatically.

File format

x z

%example%

0 1

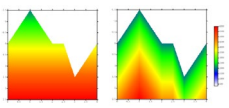
1 5

10 3

The min of x and max of x should exceed the range of the model x!

The interface file format is the same.

gradient0 doesn't consider the topography, gradient1 consider the topography!



Left is gradient0, right is gradient1

4. FsmSetting file

File format

```
NUMBER OF SWEEPING: 8    -fast-sweeping times
REFRACTION TTFIELD PRINT: NO      -yes or no(output travel time file)
REFLECTION TTFIELD PRINT: NO      -yes or no(output travel time file)
PRECONDITION GRADIENT: YES        -yes or no(Hessian precondition)
PRECONDITION DAMPING: 0.1         -damping factor for precondition
REFRACTION GRADIENT PRINT: YES    -yes or no(output gradient file)
REFLECTION GRADIENT PRINT: YES    -yes or no(output gradient file)
REFRACTION OUTROOT: Result/tmp/refrac_    -output file root
REFLECTION OUTROOT: Result/tmp/reflec_    -output file root
FILETYPE: ASCII           -"binary" or "ascii" output file type
SRS OUTROOT: Result/srs_fwd
REFRACTION SRSDRAW OUTROOT: Result/tmp/srs_fwd_refracdraw
REFRLETION SRSDRAW OUTROOT: Result/tmp/srs_fwd_reflecdraw
```

5. InvSettting file

```
NUMBER OF ITERATION: 500        -Max Iteration
VELOCITY PERTURBATION: 0.3      -Max Velocity perb. in one step in km/s!
OUTPUT TMP: NO                  -do you want to output result every iteration
TARGET MISFIT: 0.0              -target misfit
VELOCITY CONSTRAINT: 1.6 7.0    -model min and max constraint in km/s
SMOOTH TYPE: gauss              -"gauss" or "movingaverage"
MOVINGAVERGE PARAMETER: 25 5 5 -x_step y_step smooth_times(mav)
GAUSSFILTER PARAMETER: 0.3 0.1 4 20 -fracx fracy vref frequency(Gauss)
STEPLENGTH CHOOSE: 1            -"1" "2" or "3"
FILETYPE: ASCII                 -"binary" or "ascii"
LOGFILE TYPE: Result/logfile_tomography.dat  -Logfile!
OUTPUT ROOT: Result/vel.dat
OUTPUT TMP ROOT: Result/tmp/vel_inv_
```

We offer two smooth types: gauss smooth and moving average

We offer three step length choice : 1: Golden section research

2: in experience

3: formula (don't recommend)

If you chose "1", it's better to give a corresponding larger velocity perturbation(like 1 or 2 km/s)

If you chose "2", it's better to give a corresponding samller velocity perturbation(like 0.2 or 0.3 km/s)