Instructions to run Stratigraphy-Modeling code

Download all the files from https://github.com/FrankTsai-1/Stratigraphy-Modeling. Place input files and source code files in the same folder before compiling and running the code. Output files are produced in the same folder.

1. Input Data Preparation

Input Data File: Geo_model.inp

The text file Geo_model.inp contains requires parameter values to run to code. Details of the parameters are in Table 1:

Table 1: Input parameters for Geo_model.inp

Parameter	Description
NCELL	Number of 2D grid cells in GripTop.csv
NWellLog	Number of well logs in WellLogs.csv
MaxLithoBed	Maximum number of lithology beds in a well log
dipDirection	Dip direction (degrees), e.g., 0: East; 90: North; 180: West; and 270: South
dipAngleS	Minimum value of dip slope at pivot plane
dipAngleE	Maximum value of dip slope at pivot plane
ElevP1	Elevation at pivot plane, above which the dip slope is dipAngleS (feet)
ElevP2	Elevation at pivot plane, below which the dip slope is dipAngleE (feet)
StartElev	Start elevation of the stratigraphy model at pivot plane (feet)
EndElev	End elevation of stratigraphy model at pivot plane (feet)
DZ	Vertical interval between planes (feet)
ThickMin	Minimum allowed thickness of facies in the stratigraphy model (feet)
cutoff	Cutoff value between 0 and 1 for indicator natural neighbor interpolation
NMinLogs	Minimum number of well logs for interpolation
SearchRange	Distance from tile boundaries to select well logs for interpolation (meters)

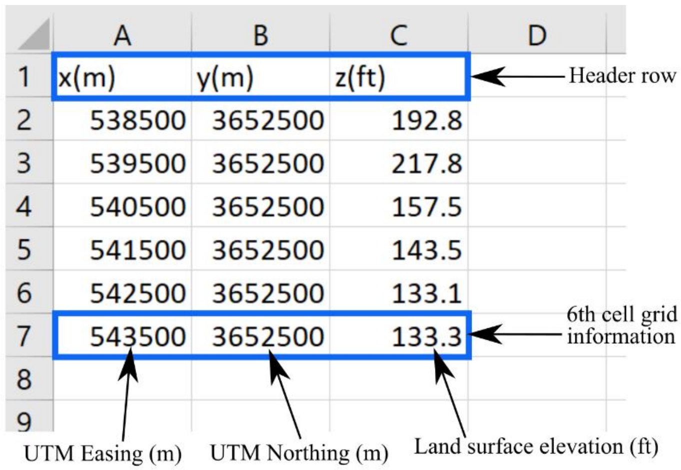
Input Data File: GridTopo.csv

The csv file "GridTopo.csv" contains the coordinates and elevations of cell centers in a 2D grid. The coordinates are the Cartesian coordinates, (x, y) in meters. The (x,y) coordinates can be replaced by the Universal Transverse Mercator (UTM) easting and north in meters. Elevations are in feet. Figure 1 shows the content of GridTopo.csv for the example. The first row is the header, which is not read by the code. Starting from row 2, each row represents one grid cell.

Column A: x coordinates of cell centers

Column B: y coordinates of cell centers.

Column C: elevations of cell centers.



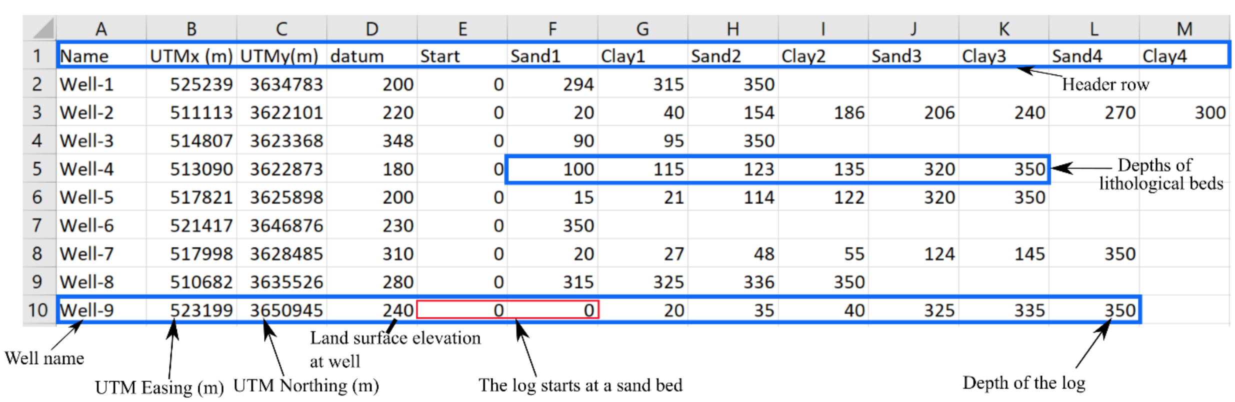
	A	B	C	D
1	x(m)	y(m)	z(ft)	
2	538500	3652500	192.8	
3	539500	3652500	217.8	
4	540500	3652500	157.5	
5	541500	3652500	143.5	
6	542500	3652500	133.1	
7	543500	3652500	133.3	
8				
9				

Figure 1: GridTopo.csv for the example.

Input Data File: WellLogs.csv

The csv file WellLogs.csv contains a sequence of clay and sand facies in well logs. Figure 2 shows WellLogs.csv for the example. The first row is the header. Data starts from row 2. Each row carries data for a well log. The lithological bed sequence starts with clay facies. If a well log starts with sand facies, top clay and the first sand have the same depth (see red box in Fig. 3).

Column A: well names
Column B: x coordinates of wells
Column C: y coordinates of wells
Column D: elevations of wells
Column E: start depth of top clay
Column F: start depth of 1st sand
Column G: start depth of 1st clay
Column H: start depth of 2nd sand
Column I: start depth of 2nd clay
…



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Name	UTMx (m)	UTMy(m)	datum	Start	Sand1	Clay1	Sand2	Clay2	Sand3	Clay3	Sand4	Clay4
2	Well-1	525239	3634783	200	0	294	315	350					
3	Well-2	511113	3622101	220	0	20	40	154	186	206	240	270	300
4	Well-3	514807	3623368	348	0	90	95	350					
5	Well-4	513090	3622873	180	0	100	115	123	135	320	350		
6	Well-5	517821	3625898	200	0	15	21	114	122	320	350		
7	Well-6	521417	3646876	230	0	350							
8	Well-7	517998	3628485	310	0	20	27	48	55	124	145	350	
9	Well-8	510682	3635526	280	0	315	325	336	350				
10	Well-9	523199	3650945	240	0	0	20	35	40	325	335	350	

Figure 2: WellLogs.csv for the example.

2. Compile and Run Code

The code includes the main file in Fortran 90 file (Lithology.F90) and subroutines of the natural neighbor interpolation method in Fortran 77 (nn_int.f). The code is simple Fortran 90 and Fortran 77, and should be able to be compiled on most modern Fortran compilers.

3. Output Data Files

Output Data File: geomodel.prn

After preparing the input files, all the Fortran codes in repository and input files are copied to the same directory. File Lithology.F90 is the root code which needs to be compiled. The other Fortran codes are called in the Lithology.F90. Running the code, three output files are generated: geomodel.prn, Geo-model.dat, and Geo-model_no_thin.dat.

The text file geomodel.prn documents data and model information during execution of the code, including plane numbers, number of well logs used for interpolation at each plane, running time, etc.

Output Data File: Geo-model.dat

The text file Geo-model.dat shows the modeled top elevations of sand and clay facies for each 2D grid cell. Figure 3 shows Geo-model.dat for the example, which include 5 columns.

Column 1: ID of the 2D grid cells. The order of cell IDs is the same as that of grid cells in TopoGrid.csv

Column 2: x coordinates of cell centers, the same as those in GridTopo.csv Column A

Column 3: y coordinates of cell centers, the same as those in GridTopo.csv Column B

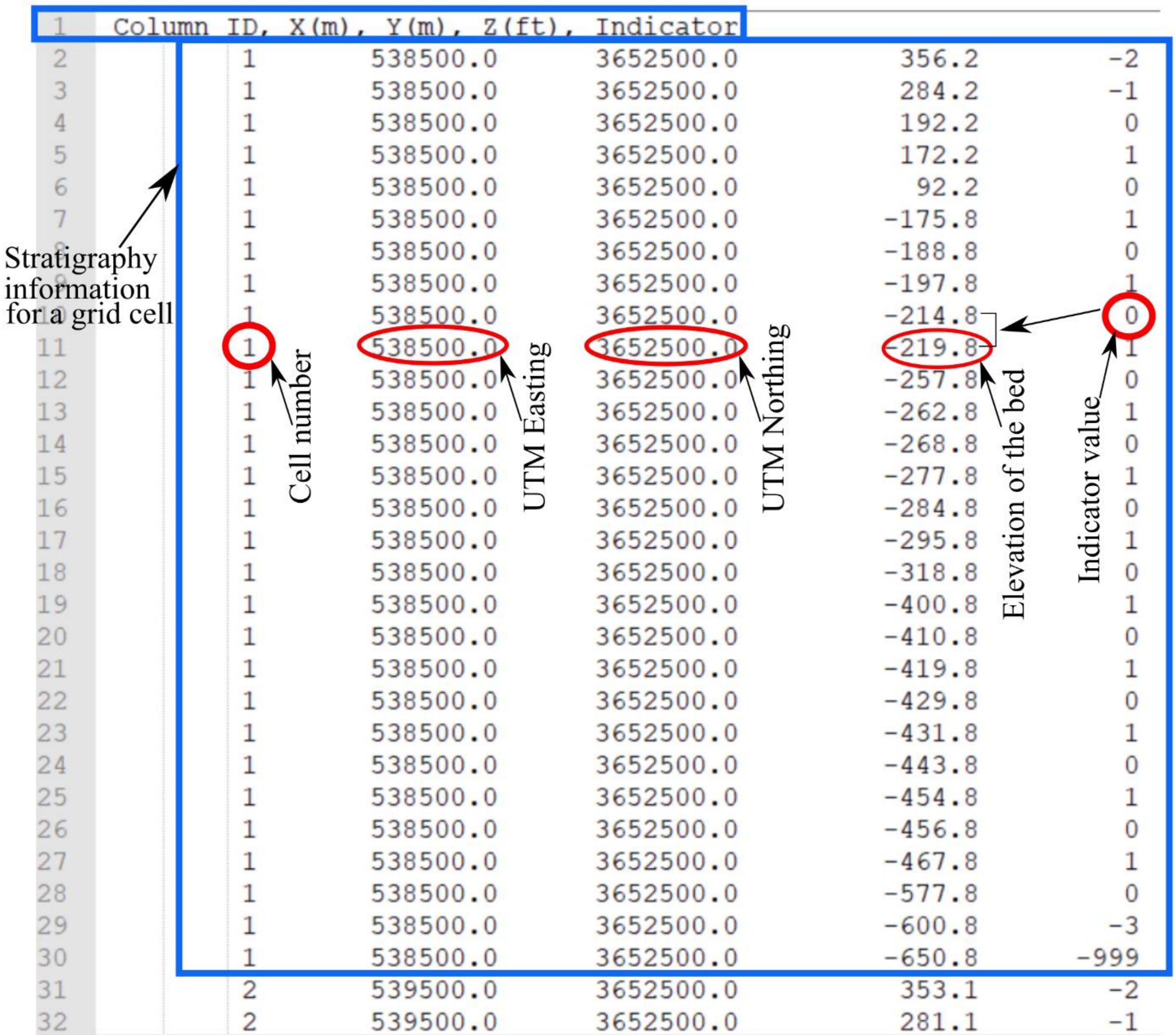
Column 4: top elevations of facies

Column 5: indicator values of facies

- 0: clay facies
- 1: sand facies
- -1: elevation above land surface
- -2: number of well logs at this elevation less than *NMinLogs*
- -3: elevation below *EndElev*
- -999: End elevation for a grid cell

Output Data File: Geo-model_no_thin.dat

The text file Geo-model_no_thin.dat has the same data structure as Geo-model.dat except for facies thinner than *ThickMin*.



Column ID	X(m)	Y(m)	Z(ft)	Indicator
1	538500.0	3652500.0	356.2	-2
1	538500.0	3652500.0	284.2	-1
1	538500.0	3652500.0	192.2	0
1	538500.0	3652500.0	172.2	1
1	538500.0	3652500.0	92.2	0
1	538500.0	3652500.0	-175.8	1
1	538500.0	3652500.0	-188.8	0
1	538500.0	3652500.0	-197.8	1
1	538500.0	3652500.0	-214.8	0
1	538500.0	3652500.0	-219.8	1
1	538500.0	3652500.0	-257.8	0
1	538500.0	3652500.0	-262.8	1
1	538500.0	3652500.0	-268.8	0
1	538500.0	3652500.0	-277.8	1
1	538500.0	3652500.0	-284.8	0
1	538500.0	3652500.0	-295.8	1
1	538500.0	3652500.0	-318.8	0
1	538500.0	3652500.0	-400.8	1
1	538500.0	3652500.0	-410.8	0
1	538500.0	3652500.0	-419.8	1
1	538500.0	3652500.0	-429.8	0
1	538500.0	3652500.0	-431.8	1
1	538500.0	3652500.0	-443.8	0
1	538500.0	3652500.0	-454.8	1
1	538500.0	3652500.0	-456.8	0
1	538500.0	3652500.0	-467.8	1
1	538500.0	3652500.0	-577.8	0
1	538500.0	3652500.0	-600.8	-3
1	538500.0	3652500.0	-650.8	-999
2	539500.0	3652500.0	353.1	-2
2	539500.0	3652500.0	281.1	-1

Figure 3: Geo-model.dat for the example.