GMS 7.0 TUTORIALS

Stratigraphy Modeling – Horizons, TINs and Meshes

1 Introduction

This tutorial builds on the concepts taught in the tutorial entitled *Stratigraphy Modeling – Horizons and Solids*. In that tutorial, you created solids using horizons defined on boreholes and cross sections. In this tutorial you will learn how to use TINs to assign horizon surfaces, and how to create three-dimensional finite element meshes from the horizon data.

1.1 Contents

1.2 Outline

This is what you will do:

1. Import scatter data.
2. Create a meshing conceptual model.
3. Create horizon TINs
4. Create a 3D mesh from the horizons.

1.3 Required Modules/Interfaces

You will need the following components enabled to complete this tutorial:

- Sub-surface characterization
- Mesh
- Geostatistics
- Map

You can see if these components are enabled by selecting the *File* | *Register*.

2 Getting Started

Let's get started.

1. If necessary, launch GMS. If GMS is already running, select the *File* | *New* command to ensure that the program settings are restored to their default state.

3 Overview

Creating a three-dimensional mesh of soil stratigraphy using the horizons approach in GMS is quite simple. First, we will read in some scatter set data. Second, we will create a meshing conceptual model. Then we will use the conceptual model and scatter data to create the TIN horizon surfaces. Finally, we will execute the *Horizons → 3D Mesh* command to create a three-dimensional mesh.

4 Reading Scatter Data

The first step in the construction of the 3D mesh is to import the scatter data. Scatter data can be entered into GMS manually, or the data can be read from a file. In the interest of time, we will read in a previously prepared file.

To read in the file:

1. Select the *Open* button  .
2. Open the directory entitled **tutfiles\Stratigraphy Modeling\horizons**.
3. Select the file named **scatter.gpr**.
4. Click on the *Open* button.

You should now see a 3D view of some scatter sets.

5 Constructing the Meshing Conceptual Model

We will first construct a conceptual model using the map module. The conceptual model will contain a coverage that is used to define the TIN layers and a 2D mesh. The 2D mesh is used to define the topology and boundary of the 3D mesh.

5.1 Setting up the Conceptual Model

1. In the *Project Explorer* right-click on the empty space and then, from the pop-up menu, select the *New* | *Conceptual Model* menu command.
2. Change the *Name* to **Case1**.
3. Change the *Type* to **FEMWATER** and select *OK*.

We aren't actually going to create a FEMWATER model, but we do need a coverage that can be used to create a 2D mesh, and the FEMWATER conceptual model has that.

4. Right-click on the new conceptual model and select the *New Coverage* command.
5. Change the *Coverage name* to **mesh1**
6. In the list of *Areal Properties*, turn on **Meshing options**.
7. Select *OK* to exit the *Coverage Setup* dialog.

5.2 Creating the Meshing Polygon

Now we will create a polygonal boundary.

1. Select the *Plan View* button
2. Select the *Create Arc* tool .

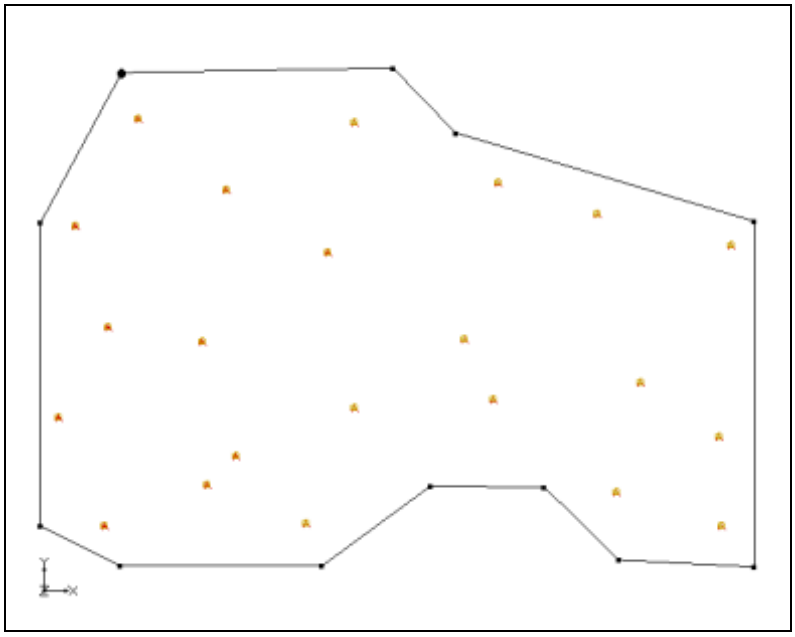

Figure 1. Map Polygon Surrounding scatter data

3. Click out a polygon, similar to the one in the figure above. Single click in the upper left portion of the graphics window to begin creating the polygon. Click out the rest of the points that make up the polygon. Click on the starting point to finish creating the polygon.
4. Select the *Feature Objects* | *Build Polygons* menu command.
5. Switch to the *Select* tool .
6. Right-click on the arc that you just created and select the *Redistribute Vertices* command from the pop-up menu.
7. In the *Arc redistribution* section of the dialog make sure that the *Specified Spacing* option is selected.
8. Enter a value of **150** for the spacing and click *OK*.

6 Creating Horizon Surfaces

We will now use the polygon that we have defined to create the TIN horizons.

6.1 Create the Tins

1. Right-click on the *mesh1* coverage and select the *Map To* | *TIN* command.
2. Change the *TIN name* to **Case1_Hor4**.
3. Set the *TIN material* to **Fine Sand**.
4. Change the *Horizon ID* to **4**.
5. Select *OK*.
6. Repeat the above steps to create 3 more TINs from the coverage with the following properties.

	1	2	3
TIN Name:	Case1_Hor3	Case1_Hor2	Case1_Bot
TIN Material:	Silty Clay	Silty Sand	Bedrock
Horizon ID:	3	2	0

6.2 Interpolate

Next we will interpolate the layer elevations from the scatter sets to the TINs.

1. In the *Project Explorer* select the TIN titled **Case1_Hor4** to make it active.
2. In the *Project Explorer* select the **top1** data set under the **Case 1** scatter set to make it active (you may need to expand the **Case 1** scatter set).
3. Right-click on the *Case 1* scatter set and select the *Interpolate To* | *Active TIN* command.
4. Select *OK* to interpolate the values.
5. In the *Project Explorer*, expand the **Case1_Hor4** TIN so you can see its data sets.
6. Right-click on the data set titled **default** and select the *Delete* command.
7. Repeat the steps above to interpolate all of the remaining layer elevations to the corresponding TIN horizons. The following table summarizes the data sets to interpolate to each horizon layer.

Case 1 Scatter Set Data Set	TIN
bot1	Case1_Hor3
bot2	Case1_Hor2
bot3	Case1_Bot

8. After doing the interpolation for all the TINs, make sure you delete all the **default** data sets on all the TINs.

6.3 View The Surfaces

To view the horizon surfaces:

1. Select the *Oblique View* button .
2. Select the *Rotate* tool and drag the mouse in the graphics window to rotate the view.

6.4 Organize TINs Into a Folder

We will now organize the TINs into a folder to be used in the Horizons process.

1. In the *Project Explorer*, right-click on the *Tin Data* folder and select the *New Folder* command.
2. Change the *name* of the folder to **Case1**.
3. In the *Project Explore*r move the four TINs so that they are all inside the *Case1* folder (drag and drop each TIN).

7 Creating the Mesh

We are now ready to create the mesh from the TIN horizons.

1. Right-click on the *mesh1* coverage and select the *Map To | 2D Mesh* command. This 2D mesh is needed in order to generate the 3D mesh.
2. Select the *TIN Data* folder .
3. Select the *TINs | Horizons → 3D Mesh* menu command.

This brings up the *Horizons to 3D Mesh* wizard in which we will pick the interpolation scheme used to create the mesh. Also, we will specify how the top and bottom elevations of the stratigraphy model will be determined.

4. On the first page of the wizard select the *Select TIN folder* option.
5. Select the **Case1** folder in the tree window and click the *Next* button.
6. In the *Top elevation* section of the dialog select the *TIN elevations* option. This means that the specified TIN surface will be used in interpolating to the top of the 3D Mesh
7. Select the **Case1_Hor4** TIN to be used as the top elevation in the tree window.
8. In the *Bottom elevation* section of the dialog select the *TIN Elevations* option and select the **Case1_Bot** TIN.

9. Click the *Next* button.
10. In the *Interpolation method* section of the dialog select the *Inverse distance weighted* option.
11. Select the *Finish* button.

7.1 Viewing the 3D Mesh

To view the Mesh:

1. Select the *3D Mesh data* folder.
2. Select the *Display Options* button .
3. Turn on the *Element faces*.
4. Select the *OK* button.
5. Select the rotate tool and drag the mouse in the graphics window to rotate the view.

You have created a simple 3D Mesh consisting of three layers of different materials.

8 Other Scenarios

Included in the project file are four other scatter sets that can be used to create different layer elevations. You could interpolate these values to the TIN horizons and create different meshes.

9 Conclusion

This concludes the tutorial. Here are some of the key concepts in this tutorial:

- TINs can be used to create horizon surfaces
- A 3D mesh can be created directly from horizon data
- The horizons command can operate on just a subset of the TINs or boreholes in the project.