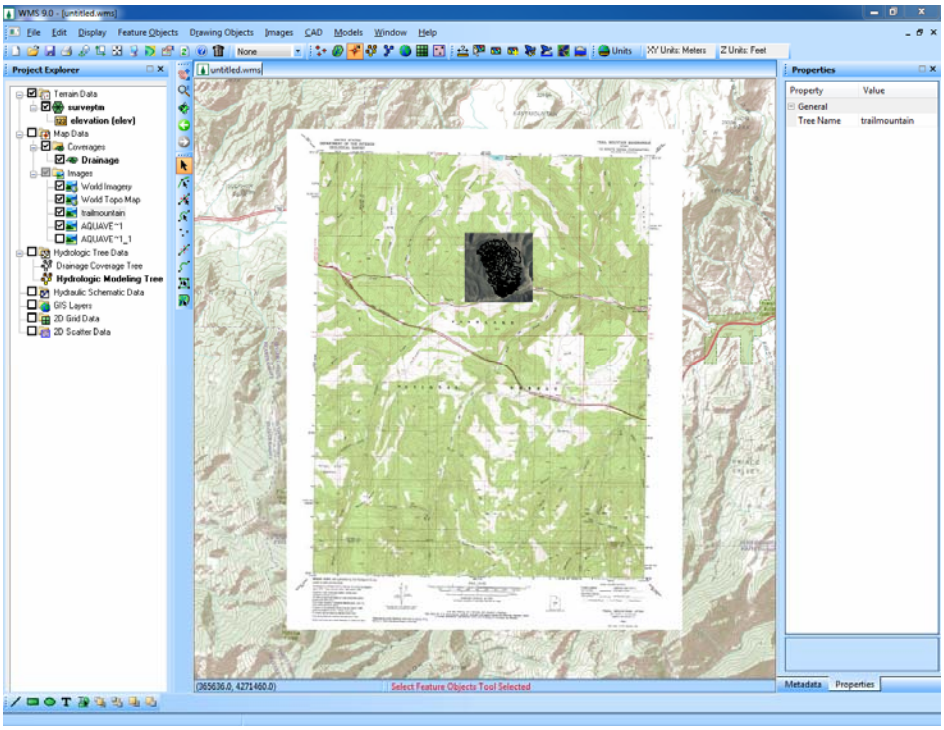
WMS

v. 9.0

WMS 9.0 Tutorial

Editing Elevations – Using TINs

Import, view, edit, convert, and digitize triangulated irregular networks using a variety of methods



Objectives

Import survey data in an XYZ format. Digitize elevation points using contour imagery. Edit and merge TINs and convert between DEMs and TINs. Export TIN contours to a CAD file.

Prerequisite Tutorials

- None

Required Components

- Data
- Map

Time

- 30-60 minutes

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1 Contents

2 Introduction

Triangulated Irregular Networks (TINs) are constructed from a scattered set of xyz vertices. They can be used for visualization, as background elevation maps for generating new TINs or DEMs, or to obtain cross sections for hydraulic models. WMS has powerful tools for importing and manipulating TIN data.

3 Objectives

The following topics will be covered in this exercise:

1. Importing survey data
2. Digitizing data
3. Triangulation
4. Automated TIN editing
5. Manual TIN editing
6. Creating a TIN using a conceptual model
7. Converting a TIN to a DEM
8. Exporting data to CAD

4 Importing Survey Data

1. Close all instances of WMS
2. Open WMS

3. Select ***File | Open*** 
4. Locate the ***tins*** folder in your tutorial files. If you have used default installation settings in WMS, the tutorial files will be located in ***\My documents\WMS 9.0\Tutorials\.***
5. Open *"surveytm.txt"*
6. Leave the default settings. This is a tab delimited file exported from Excel. Select *Next*
7. For WMS data type choose *Survey Data*
8. In the File preview spreadsheet, ensure that the first, second, and third column types are mapped to X, Y, and Z, respectively
9. Select *Finish*
10. Right-click on s*urveytm* under *Terrain Data* in the Project Explorer and select ***Display Options***  from the pop-up menu.
11. Toggle on *Unlocked Vertices* in the *Tin Data* options
12. Select *OK*

You should now see the points from the *surveytm.txt* file you read.

13. Select ***Edit | Current Projection...*** to set your current coordinates
14. Select the *Global Projection* option
15. Select *Set Projection*
16. Set *Projection* to *UTM*, *Datum* to *NAD 27*, *Planar Units* to *Meters*, and *Zone* to *12 (114°W - 108°W – Northern Hemisphere)*
17. Select *OK*
18. Set Vertical Units to *U.S. Survey Feet*
19. Select *OK*

5 Getting a Background Image

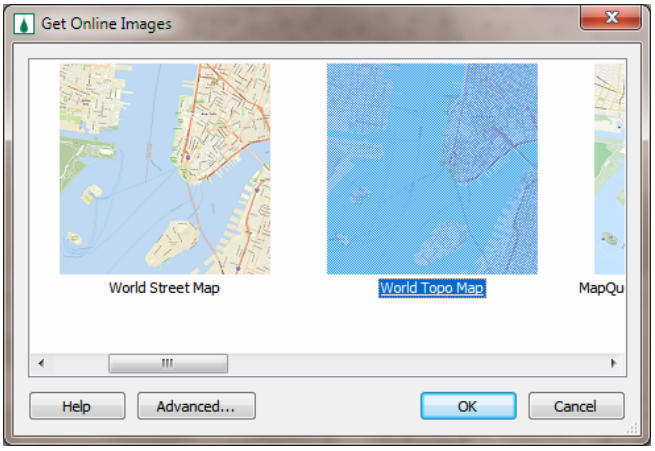
Skip section 5.1 if you are not able to connect to the Internet using your computer.

5.1 Getting a Background

Using an Internet connection we can load a background image (Aerial photo or a topo map) for the project site. WMS uses built in web services tool to load such images.

1. Select the *Get Online Maps* tool  located near the menu bar. It will open *Get online Images* dialog.
2. Select *World Imagery* and click *OK*. WMS will load the background image file. It will take few moments depending upon the internet connection. Once done, you can see an aerial photo added to the background.

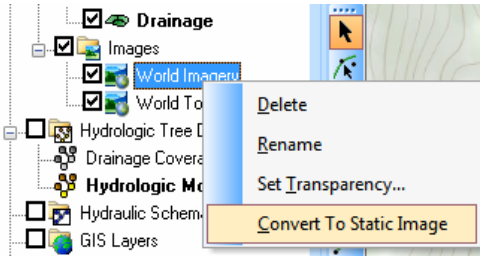
3. Select the *Get Online Maps* tool again. This time we will load the topo map.
4. Scroll to the right and select *World Topo Map* and click *OK*.



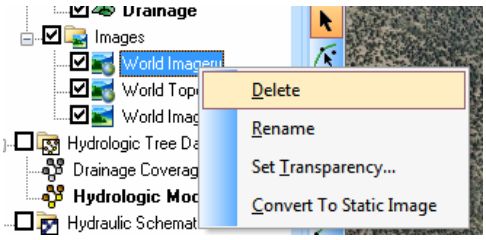
5.2 Create a local copy of the images

The images you just loaded are read in from the server and sometimes take longer time to zoom and pan around. You can create a local copy of the image to expedite such navigations.

1. In the project explorer, under *Images* folder, right click one of the images and select *Convert To Static Image.*



2. Select *OK* to accept suggested value of *resample magnification.* Resample magnification factor of 1 means the image will have exactly as many pixels as it is being displayed on the screen. You can increase the factor if you need a higher resolution image. But, note that it will take longer time to download.
3. WMS will download the image to your local drive. You can see the download progress.
4. Repeat the same process for another image.
5. Once both the images are downloaded, you can remove the bigger online images (the ones that have little *globe* on their icons.



If you were able to successfully complete all the steps in this section you can skip section 5.3.

5.3 Open Background Image

1. Select ***File*** | ***Open*** 
2. Open *"trailmountain.tif"*
3. Zoom in around the vertices

6 Digitizing Data

1. Select ***Display*** | ***Toolbars*** | ***Digitize*** to turn on the Digitize toolbar at the bottom of the screen
2. Click on the *Digitize Mode* button, which is located on the Digitize toolbar, to turn on the digitize mode
3. Enter a Z value of **6800** ft in the white box
4. In the *terrain data* module  , select the *Add Vertices* tool  from the TIN toolbar (make sure you do not select the *Create Feature Point* tool from the Feature Objects toolbar—it looks the same as the *Add Vertices* tool)
5. Digitize the 6800 ft contour by using the background image to add vertices
6. Click on the *Digitize Mode* button, which is located on the Digitize toolbar, to turn off the digitize mode
7. Select ***Display*** | ***Toolbars*** | ***Digitize*** to turn off the Digitize toolbar at the bottom of the screen

7 Converting CAD Data to a TIN

Often terrain data is stored or processed in a CAD program in the form of contours or triangles. In either case the 3D data points (x,y,z) can be converted from the CAD data to TIN points and triangulated in WMS.

1. Select ***File*** | ***New*** 
2. Select *No* when asked if you want to save changes
3. Select ***File*** | ***Open*** 
4. Open *"contours.dwg"*

5. Switch to the *Map* module
6. Select ***CAD | CAD->TIN***
7. Select *OK*

The points defining the contour lines contain x, y, and z coordinates so when the points are converted to TIN points and retriangulated, you are left with a 3D TIN surface. You can zoom in, rotate, change the display or contour options in order to better visualize your TIN if you would like. You can also read other CAD files with 3D points and convert them to a WMS TIN.

8 Merging TINs

Sometimes, especially when building a hydraulic model, you will want to merge elevation data from different sources together into a single TIN or DEM. For example, you might have survey data that represents the bathymetry of a stream channel stored as contours in a CAD program that you want to merge with DEM data from the USGS. Merging data from several sources can be especially useful for hydraulic modeling applications. In many hydraulic modeling applications you need to "cut" cross sections that include both the channel geometry (obtained from a survey of the channel) and the floodplain (obtained from a USGS DEM).

Merging two or more elevation data sources into a single TIN is a 3-step process. First, you need to make sure the coordinate systems of each set of elevation data match each other…all the elevation data needs to "line up" and all the elevations should either be in US Customary or SI units. Second, convert each set of elevation data to a separate TIN. Third, merge all of your TINs into a single TIN using the merge TINs command. This section of the tutorial will show how these three steps are used to merge separate elevation sources in the WMS.

1. Select ***File | New***
2. Select ***File | Open***
3. Open *"tmcontours.dwg"*

"tmcontours.dwg" is a DWG file from a CAD program containing contours for a small area. You want to merge the elevation data in this file with data from a DEM. First, you will convert this DWG file to a TIN. To convert this file, you first want to convert these contour lines to arcs. Then, you will redistribute vertices on the arcs. Finally, you will convert the arcs with the redistributed vertices to a TIN. When you have contour lines, you normally do not want to convert them directly to a TIN because the vertices along each contour line might be at a random or undesirable spacing to generate a quality TIN.

4. Switch to the *Map* module
5. Select ***CAD | CAD -> Feature Objects***
6. Turn off all the layers except *CAD layers_arcs*
7. Select *OK*
8. Change the Coverage type to *General* and select OK to create the *CAD layers* coverage
9. Select ***CAD | Delete***

10. Select the *Select Feature Arc* tool 
11. Use ***Edit | Select All*** to select all feature arcs
12. Select ***Feature Objects | Redistribute***
13. Enter a Spacing of **20**
14. Select *OK*

When you redistribute the vertices, WMS interpolates elevations for any new vertices on the arc from existing arc vertices. You have now redistributed the vertices on the arcs to a good spacing and are ready to convert the contours to a TIN.

15. Select ***Feature Objects | Arcs -> TIN Vertices***
16. Right-click on the TIN that was created (New tin) in the project explorer and select ***Triangles | Triangulate*** on the pop-up menu
17. Switch to the *Map* module 
18. Select ***Feature Objects | Delete*** to delete all of your original contour data from this session of WMS
19. Select *OK* to clear all of your map module data
20. Select ***File | Open*** 
21. Open *"trailmountain.dem"*
22. Select *OK* in the "Importing USGS DEMs" dialog

You have now read a USGS DEM. To merge this DEM with the TIN you have just created from the CAD contours, you need to convert the DEM to a TIN and make sure all your TINs are in the same coordinate system. Currently, the XY projection of your DEM and TIN are in meters in the same UTM coordinate system, but the elevations on your DEM are in Meters while the elevations on your TIN are in feet.

23. Under Terrain Data in the project explorer, right-click on the New tin and rename the TIN to "CAD Contours"
24. Right-click on the DEM and select ***Convert | DEM -> TIN | All***
25. Turn on the *Delete DEM* option (leave everything else as originally set) and select *OK*
26. In the project explorer, right-click on the "CAD Contours" TIN and select ***Coordinate Conversion***
27. Select the *Global Projection* radio button in the *Object Projection* section in the Reproject Object dialog
28. Set *Projection* to *UTM*, *Datum* to *NAD 27*, *Planar Units* to *Meters*, and *Zone* to *12 (114°W - 108° W – Northern Hemisphere)*
29. Select *OK*
30. Set the Vertical Projection to *NGVD 29(US)* and the Units to *U.S. Survey Feet*
31. Select *OK*

32. In the project explorer, right-click on the "CAD Contours" TIN and select ***Merge***
33. In the Merge TINs dialog, select the *All –>* button.

To merge these TINs together and delete any regions of overlap between the TINs, you must order your TINs in the correct order in the list of TINs to merge. They should be ordered in the priority used for merging TINs. Put your least accurate TIN at the top, the most accurate at the bottom.

34. Select the *Delete overlapping regions* button.
35. Move your TINs up or down so the *CAD Contours* TIN is at the bottom and the TIN from your DEM (*New tin*) is at the top.
36. Select *OK* and wait while your merged TIN is generated from your existing TINs.
37. Select *OK*
38. In the project explorer, select the *CAD Contours* and *New tin* TINs and hit the *Delete* key to remove these TINs now that you are done with them.

You have now created a merged TIN that is a combination between your CAD contours and your USGS DEM. You could use this TIN for hydraulic modeling or could convert this TIN to a DEM so it can be used for hydrologic modeling.

9 Triangulation

In order to edit the TIN according to the steps in this exercise we will delete the existing data and read in a TIN file before we triangulate the data.

39. Select ***File*** | ***New*** 
40. Select ***File*** | ***Open*** 
41. Open *"digitizetm.tin"*
42. Right-click on the TIN (New tin) in the Project Explorer and select ***Triangles*** | ***Triangulate*** on the pop-up menu.

10 Automated TIN Editing

WMS has automated methods of editing TINs to provide a representation of terrain that is useful for drainage analysis. These methods include data transformations and eliminating flat triangles and pits. Data transformations may be useful for repositioning data if it is not originally located in the correct position because of survey errors or an unknown coordinate system. After transforming coordinates, you should always set your current projection system if it is known. Capabilities to eliminate flat triangles and pits still exist in WMS, but they are seldom needed since flat triangles and pits pose few problems when using the DEM-based watershed delineation tools in WMS.

10.1 Transformations

Run the cursor over the TIN and notice that the z values in the help strip at the bottom of the WMS window are in feet. The XY values on this particular TIN are in meters, and you want the X, Y, and Z units all in meters so they match when you delineate a watershed. In this section, you will convert the Z values from feet to meters. You would normally do this using the coordinate conversion tool. This section simply demonstrates how the transform tool works.

1. Select ***TIN | Vertices | Transform***
2. Enter **0.3048** for the Z Scale value to scale the elevations in feet to meters

Notice that there are several other options for transforming TIN vertices, including options to translate and rotate vertices on the entire TIN.

3. Toggle on the *Frame image after transformation* option
4. Select *OK*

Run the cursor over the TIN and notice that the z values in the help strip are now in meters.

11 Converting a TIN to a DEM

If you are delineating a watershed, you will want to convert your TIN to a DEM. This section demonstrates how to delineate a watershed from a TIN by converting the TIN to a DEM.

1. Right-click on the TIN (New tin) in the Project Explorer and select ***Convert | TIN->DEM*** on the pop-up menu.
2. Enter a cell width and cell height of **10**
3. Select *OK*
4. Select *Yes*
5. Switch to the *Drainage* module 
6. Select ***DEM | Compute Flow Direction/Accumulation…***
7. Select *OK*
8. Select *OK*
9. Select *Close* once TOPAZ finishes running (you may have to wait a few seconds to a minute or so)
10. Select ***Display | Display Options*** 
11. Select *DEM Data* and change the Minimum Accumulation For Display to **0.05** mi^2
12. Select *OK*
13. Select the *Create Outlet Point* tool 
14. Create an outlet as shown in Figure 11-1

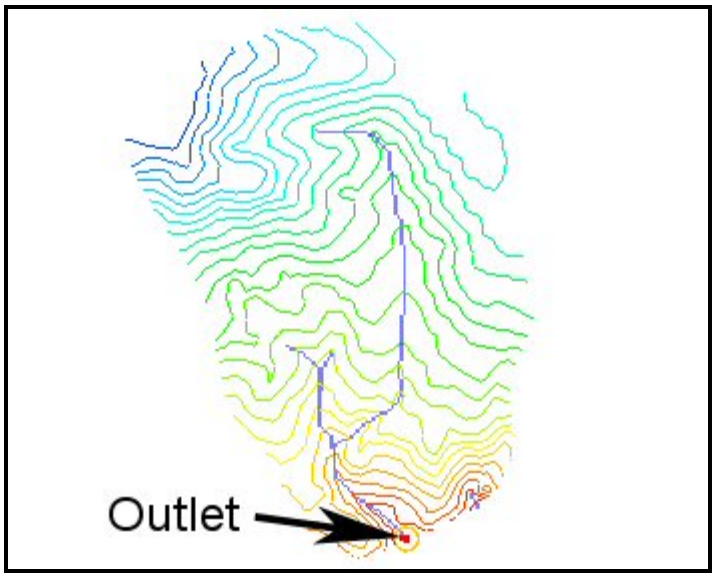


Figure 11-1: DEM outlet

15. Select ***DEM | Delineate Basins Wizard***
16. Select *Delineate Watershed*
17. Select *Close*
18. A drainage boundary is created using the DEM data. The basin data for this drainage basin is computed

12 Exporting Data to CAD

Data that is visible on the screen can be converted to CAD data and then saved for use in CAD programs.

1. Switch to the *Map* module
2. Select ***CAD | Data -> CAD***

In order to view only the newly created CAD data we will hide all other data.

3. Hide the Map Data Coverages folder in the Project Explorer by toggling its visibility check box off
4. Hide the Terrain Data folder in the Project Explorer
5. Select ***Display | Display Options***
6. Select *DEM Data* and toggle *Color Fill Drainage Basins* and *Fill Basin Boundary Only* off
7. Select *OK*
8. Select ***CAD | Display Options***
9. In the Visibility column toggle "Drainage_arcs" off
10. Select *Apply*. Notice the CAD data that disappears when selecting this button

11. Select *Cancel*
12. Select ***File | Save As***
13. For Save as type choose the *DWG files (*.dwg)* filter
14. Enter a filename and select *Save*

