Geology 340 - Images of the Earth

# (70 points total)

# Lab 3: Computer Contouring Laboratory

**Introduction:** This week we will explore the differences between computer contouring and hand contouring of a hypothetical elevation data set. You will use several different methods for computer contouring.

**Preparation:** This lab uses GMT to produce contour maps. You’ll need to have installed GMT on whatever computer you’re working on. See the Lab 2 handouts (available on the course web page) if you need to review how to install GMT.

For this lab, you’ll need to download the data sets from the course web page so that you can work on it. Go to the course web page:

<http://guilfordgeo.com/geo340>

and click on the link marked ***Lab 3 Data.*** Open this file to extract two data sets you’ll need to the GMT directory. Change the folder to “H:\GMT” if you have an H: drive on a school computer. See here:

This should put two files, elev.xyz and badcontours.xyz, into your GMT directory. In your GMT folder, use Notepad++ to see the contents of the data file. The points are each three numbers: x – y – elevation.

Programs: We’ll be using four programs today:

***makecpt*** – this program creates a color palette table (cpt) that is used by other programs to draw contour lines and shadings

***pscontour*** – this program can take xyz files and draw contour lines around them using the triangulation technique we discussed in class

***surface*** – this program takes xyz files and creates a smooth 3-D surface through the points in the xyz file. This is useful for creating smooth, continuous data sets from scattered points.

***grdcontour*** *–* this program takes a gridded surface such as that produced by ***surface*** and draws a contour map based on it

**Guidelines:** The data set is 99 different elevation points on a 40x40 grid (see the map handed out with this lab). All data are specified with x and y coordinates ranging from 1-40 and elevations between about 400 and 1900 feet. This means that with any of your GMT commands for this lab, you can use the following options:

* Projection: use **-JX6.5** (remember -J is the projection; JX just means to a simple XY graph). This makes your whole plot fit into a 6.5 inch square which will fit on the paper.
* Region: use **-R0/40/0/40** (remember -R is the region). I include 0 to provide an extra space at the edge of the map and to make the axes look nice.
* Tickmarks: use **–B5** or **–Ba5g5** (remember –B controls tickmarks, “a” is for annotations, and “g” is for gridlines)

**Exercises:**

1. Contour the data set provided by hand on the paper map. Use a 100-foot contour interval. Assume that the numbered elevations apply at the center of the number. (10 points)
2. Contour the data set by computer using the ***pscontour*** command. First, you'll need to use the ***makecpt*** command to create a 100-foot contour cpt file. Cpt files are color/contour interval tables - see the ***makecpt*** documentation for details. Your command might look something like this:

makecpt -Ccopper -T0/2000/100 > mycontours.cpt

Next, use the ***pscontour*** command to produce your contour map using **triangulation**. You'll need to specify your data file (in this case *elev.xyz*) and then the -J, -R, and -B options (see last page) to get it to work, and you'll need the -C option to specify your cpt file from the previous step. You also need to use –I and –W to decide how to display the contours. Your command might looks something like this:

pscontour elev.xyz –JX6.5 –R0/40/0/40 –B5 –Cmycontours.cpt –I > map1.ps

Create one map with colored zones and one with contour lines (you'll need to switch the -I and -W options to go from colors to lines). (5 points each, 10 points total)

1. **QUESTION TO ANSWER:** How does your hand-contoured map compare with this computer-contoured map? Which do you think is more accurate? Where is each of these strongest? What errors does each have? (5 points)
2. Now use the ***surface*** and ***grdcontour*** commands to produce a second computer contour map from gridded data. ***surface*** takes xyz data (your file **elev.xyz**) and creates a gridded elevation model using a 3-D spline. In the ***surface*** command, use a tension factor of zero (-T0) for now, and use an increment both x and y of 1 (-I1), and you’ll need to specify an output grid file with the –G option (e.g. –Gelev.grd). To make a map from the surface you created, use the ***grdcontour*** command, which makes a contour map from the surface. In the ***grdcontour*** command, annotate the contours (-A100). (10 points)
* **QUESTION TO ANSWER:** How does this contour map compare to the ones you produced in #2 above? Which do you think is more accurate? (5 points)
* If you’re feeling adventuresome, you can create a colored image of the surface using the ***grdimage*** command, which takes the same parameters as ***grdcontour*** except that it requires that the –C option name a **cpt** file, as in –Cmycontours.cpt (up to 5 bonus points)
1. Produce a second map using ***surface*** and ***grdcontour*** with a tension factor (-T) of 0.6. What differences can you spot from the previous map (#4)? (5 points)
2. Create another contour map using ***makecpt*** and ***pscontour***, but this time use a contour interval of 20 feet. You should be able to use the same command as in problem #2, just with a different contour interval specified in the ***makecpt*** command. How does the map look? Is this level of detail warranted from the data you started with? (5 points)
3. Look at the map labeled **Scarp**. Do a quick contour map by hand on the sheet provided. (5 points)
4. The data for the **Scarp** map are in the file called **badsurface.xyz.** Do a line contour map using ***pscontour***. (5 points)
5. Run this file through ***surface*** and ***grdcontour*** using a tension factor (-T) of zero. Notice anything weird? What is going on here? (5 points)
6. Repeat the mapping using a tension factor of 0.5 - how much does that mitigate the problem? (5 points)