# Remote Sensing - Mapping Terrain

Google Sheets Addendum

Below are instructions for generating the surface map for students who only have access to Google Sheets and cannot access Microsoft Excel. The students will generate a free account on plotly.com to create their surface map. Students will still scan their terrain with the same method outlined in the procedure and export a .csv file of their data from Graphical Analysis. Below are instructions for how to do the "3D Modeling of your data" portion of the procedure.

1. Open your .csv file from where you saved it in your Google Drive. Convert this to a Google Sheets file by going to "File" in the top right corner and selecting "Save as Google Sheets".
2. You only need the **Position** column from each data set and the **Time** column from the first data set. **Delete** all other columns (Time, Velocity, and Acceleration).
3. You also need to delete any extra data at the end of each **Position** column that goes beyond the smallest set of **Position** data that you gathered. This data is considered extraneous and is not needed.
4. **Position** is the distance between the sensor and the surface features. However, you want the **height** of the surface feature from the floor. For that, you will need to create a second set of columns, one column for each **Position** column in your data set, that calculates the height for each column in your data set. (The new columns shown below are labeled h1, h2, h3, etc.) You may have to insert more columns to the right of your original data in order to have enough columns.
5. To do this calculation, in your first new column, type an equal sign then the length of your string, then a minus sign. Now go to the first column of **Position** data and click the cell with the first data point. An example of what you should see in the cell is shown to the right.
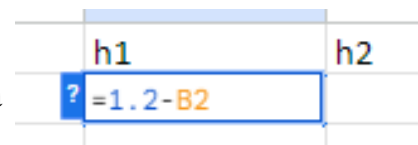
6. When you are finished with your calculation, click Enter, then click back into the cell you just calculated. A little circle should appear in the bottom right corner of the cell. Click and drag this circle across the top cell of all of your height columns to copy this calculation for all of your first data points of your **Position** data. You know you are selecting the little circle when your cursor turns into a plus sign. When you release the cursor, you should see different numbers appear at the top of all your cells. (See figure below.) Leave this data highlighted, do not click anywhere else yet.

AF	AG	AH	AI	AJ	AK	AL
h12	h13	h14	h15	h16	h17	h18
0.102	0.096	0.195	0.691	0.647	0.408	0.886

7. Now click the little circle in the bottom right of the cell in the last column and drag it all the way down to your last data point. This will copy the calculation to the rest of the data for all of the columns in your data set.
8. When you are finished setting up the height calculations, go to File, Download, and choose Comma Separated Values (.csv). Save this file where you will remember its location in your Google Drive.
9. At this point, everything has been calculated and you are ready to graph! Go to https://chart-studio.plotly.com/create/#/ and create a free account.
10. Log in and plotly should take you to a screen that looks like the figure below. Import your data using the button in the top right corner of the screen. You can upload your data by uploading the file itself or by choosing the "By URL" option and pasting the file's share link in the box.

11. Next you will create your surface chart. Click the "+Trace" button at the top of the screen. Change the type of chart by clicking Scatter (default chart) and scrolling down to choose the "3D Surface" option.

12. Click the drop down menu for the "X" data and choose your Time data.

13. Leave the "Y" data section blank. Click the drop down menu for the "Z" data and choose your first height column. You will have to do this repeatedly for all of your height data until you have something similar to the figure to the right. As you add each set of data, your surface chart should start to fill in.

14. Your surface chart should look something like the figure shown below. You can also click on your surface and drag it to change the view and look at it from different perspectives. *Note: Any large spikes or negative spikes are from noise in your original data set.*