



Tech Report 6

Using Spreadsheets: Single Station Tracking

Getting Started

A spreadsheet is a good way to start using the power of a computer to perform any number of calculations. In fact a spreadsheet is designed primarily for number crunching. Our first altitude calculator will deal with Single Station Tracking. For these exercise we are using the spreadsheet "Calc" from LibreOffice (www.libreoffice.org), although other spreadsheet programs should also work.

Single Station Spreadsheet

When looking at a spreadsheet, you will notice that there are letters going across the top and numbers down the left side. These are your coordinates in the spreadsheet. When referencing a cell, we use a combination of the letter (to identify the column) followed by the number (to identify the row). The baseline for Station A is located in Cell C4. The elevation for Station A is located in Cell C5 (see below).

	A	B	C	D	E
1	Single Station Altitude Reduction				
2					
3	Station A				
4		Baseline			
5		Elevation			
6					
7	Results				
8		Altitude		meters	
9				feet	
10					
11					

Single Station Spreadsheet in LibreOffice Calc

The numbers that will be entered by the user, in this case Cells C4 and C5, have been highlighted in yellow . The altitude figure will be displayed in C8. It is calculated by recreating the Single Station Tracking formula in a way the spreadsheet can understand and reuse.

Open LibreOffice Calc (or your favorite spreadsheet program) and create a spreadsheet that looks like the one shown in the left column at the bottom. Save your work as you go and when you are done.

Calculating Altitude

While the spreadsheet looks good, all we have really done so far is to create a form. The spreadsheet doesn't *do* anything yet. For that we must convert our formula for single station tracking into something the spreadsheet can recognize and use.

Our formula for single station altitude reduction is:

$$\text{Altitude} = (\text{Baseline distance}) \times (\text{Tangent } \angle A)$$

The 'trick' to having this work in a spreadsheet is to break down the equation and convert it into a calculation that is usable by the spreadsheet. In this case, we will recreate the entire formula and insert it into Cell C8.

Creating a Formula

When creating a formula in a spreadsheet you start with the equal sign (=). This lets the spreadsheet know that you are now entering a formula. So in Cell C8 we would start with “=”.

Next we tell the spreadsheet where it can find the data for our baseline. In this case it is located in Cell C4. So our formula at this point looks like this:

$$=(C4)$$

The next part of the formula has us multiply the baseline by tangent of Angle A. To indicate multiplication we use the star symbol (*).

The data for the angle of A is found in Cell C5. In this case we are going to use the Arc-tangent of the elevation. On our spreadsheet we will enter “ATAN”. Now our formula looks like this:

$$=(C4)*(ATAN(C5))$$

In the screen shot below you can see that Cell C8 has been selected and the formula has been entered. Because no data has been entered for Baseline or Elevation, the results are shown as 0.

	A	B	C	D	E
1	Single Station Altitude Reduction				
2					
3	Station A				
4		Baseline	100		
5		Elevation	57		
6					
7	Results				
8		Altitude	0	meters	
9				feet	
10					

Formula entered into Cell C8

Now let’s enter some data into our spreadsheet and see if it works. Enter a baseline of 100 into Cell C4, and an elevation of 57 into Cell C5. If we have entered everything correctly, it should look like the following:

	A	B	C	D	E
1	Single Station Altitude Reduction				
2					
3	Station A				
4		Baseline	100		
5		Elevation	57		
6					
7	Results				
8		Altitude	155.3254267	meters	
9				feet	
10					

Initial results in meters

There are times when we want to see the results in feet, rather than meters. This is especially true in the United States where the metric system isn’t in wide spread use. We have added Cell C9 for that use. The formula for converting meters to feet is:

$$feet = meters \times 3.2808$$

As before we enter the formula in Cell C9 starting with an equal sign. Next we want to take the answer in Cell C8 (which is in meters) and multiply it by 3.2808. Our formula in Cell C9 should appear as follows:

$$=C8*3.2808$$

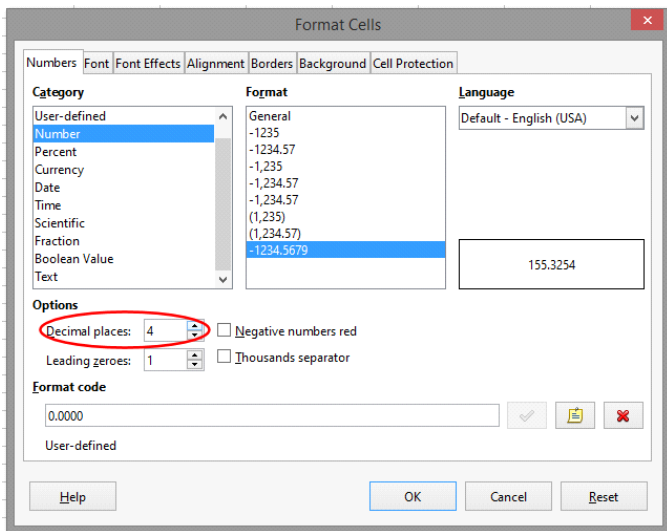
Our spreadsheet should now look like the one below:

	A	B	C	D	E
1	Single Station Altitude Reduction				
2					
3	Station A				
4		Baseline	100		
5		Elevation	57		
6					
7	Results				
8		Altitude	155.3254267	meters	
9			509.5916598	feet	
10					

Altitude results converted to feet

The results displayed in Cells C8 and C9 are taken out 12 decimal places. For our purposes we really don't need anything that precise. By reducing the visible decimal places we can make the results more readable. To do this we are going to use the Format dialog.

Begin by highlighting Cells C8 and C9. Right-click and select "Format Cells..." from the pop-up menu. You should now have a dialog box displayed on the screen. Make sure you are on the Numbers tab. About half way down the box you should see "Options" and directly below "Decimal places:" with a number box just to the right. Increase the number of places to "4" (it should look like the dialog box below), then click the "OK" button.



Format Cells dialog box in LibreOffice Calc

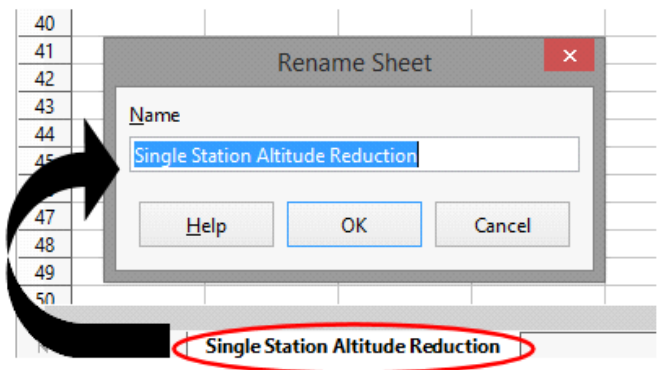
The spreadsheet should now look like the one at the top of the next column. Notice that it rounded up the altitude in Cell C9.

	A	B	C	D	E
1	Single Station Altitude Reduction				
2					
3	Station A				
4		Baseline	100		
5		Elevation	57		
6					
7	Results				
8		Altitude	155.3254	meters	
9			509.5917	feet	
10					

Altitude results reduced to four decimal places

Rename the Spreadsheet Tab

At the bottom of the spreadsheet is a tab (see below). Double-click on the tab and in the dialog box, rename the sheet "Single Station Altitude



Rename tab

Reduction" and then click the "OK" button. Finally, click on the "Save" button and save the spreadsheet as "Rocketry Calculator.ods".

You can use this calculator at any time to determine how high your model flew. Simply enter your data for the baseline and elevation into the yellow cells and let the computer calculate the results.

About LibreOffice

LibreOffice is an open source office suite, very similar to Microsoft Office. It contains a word processor (Writer), a spreadsheet (Calc), a relational database program (Base), a drawing program (Draw), a presentation program (Impress), and a formula creation program (Math). The program is developed by the non-profit *The Document Foundation*. There is no cost for the LibreOffice software, and the source code is made freely available. There are versions available for Windows (32 and 64-bit), Linux (32 and 64-bit), Mac (OS X 64 bit) and the Raspberry Pi (32-bit and 64-bit ARM). You can download it from the LibreOffice web site at <https://www.libreoffice.org>.

The software is capable of performing many tasks, much like Microsoft Office (and can even open and save Microsoft office files). We enjoy using LibreOffice as we find it a very powerful software package and capable of doing most everything we ask of it. The fact that it is available for free makes it even more enticing to use. It is updated on a regular basis, so you don't have to worry about it getting outdated.

I hope you will give LibreOffice a try as you work through this Tech Report and in future Tech Reports. However, you don't have to use Calc in these samples. You can use Microsoft Excel for your spreadsheet. In fact you can use most any spreadsheet to create these programs. You might need to check some processes as they can vary among the various software packages.



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If You Enjoy Rocketry, Consider Joining the NAR

If you enjoy model rocketry and projects such as the Arduino Launch Control System, Project:Icarus, The Dyna-Soar and others, then consider joining the National Association of Rocketry (NAR). The NAR is all about having fun and learning more with and about model rockets. It is the oldest and largest sport rocketry organization in the world. Since 1957, over 80,000 serious sport rocket modelers have joined the NAR to take advantage of the fun and excitement of organized rocketry.

The NAR is your gateway to rocket launches, clubs, contests, and more. Members receive the bi-monthly magazine "Sport Rocketry" and the digital NAR Member Guidebook—a 290 page how-to book on all aspects of rocketry. Members are granted access to the "Member Resources" website which includes NAR technical reports, high-power certification, and more. Finally each member of the NAR is covered by \$5 million rocket flight liability insurance.

For more information, visit their web site at <https://www.nar.org/>

