# Lab 3 – GPS and DGPS Positioning

**Due: 3/30/2022**

## Part I: Improved GPS Positioning

This first part you will only use the data from the static trimble receiver (RCVRT)

a) Compute the GPS position solution for the static data.
b) Now compute a carrier smoothed GPS position. How do the results compare to part a? What size window did you use (did you see any evidence of code-carrier divergence).
c) Use the ephemeris ionosphere model to improve the position solution.
d) Use dual frequency to compute an Ionsophere free measurements and re-compute the position for RCVRT.
e) ***(Optional/Bonus).*** Gather precise ephemeris from the NOAA website (assuming the government is no longer shut down as the website has been closed during the government shutdown) and perform a PPP solution. How do the satellite positions compare to before? How does the solution compare to part a? Can you utilize knowledge that you are static to improve your solution (and even solve for the Ionosphere error)?
f) Compare all of the above (completed) solutions on a single google earth image with the correct legend. Comment on the comparisons.

## Part II: Relative DGPS Positioning (zero baseline)

For this part, you will need the data from the two static receivers (i.e. RCVR0 and RCVRT) which record data from the same antenna (i.e. the baseline is 0 meters)

a) Compare the position difference between the 2 Receivers (over time). What is the range error (mean and standard deviation) between the two receivers
b) Compute the code DGPS solution (i.e. pseudorange based) between the two receivers. What is the range error (mean and standard deviation) between the two receivers.
c) Compute the carrier smoothed code DGPS solution between the two receivers. What smoothing window did you use? What is the range error (mean and standard deviation) between the two receivers.
d) Compute the RTK DGPS solution (i.e. carrier based) between the two receivers. You may choose to do a widelaned approach, use the Lamda method, or simply hand solve for the integers. Note that since the baseline is zero, the integer ambiguity should appear constant for each channel. What is the range error (mean and standard deviation) between the two receivers.

# Part III: Relative DGPS Positioning (dynamic)

For this part, you will need the data from the two dynamic Novatel receivers (i.e. RCVR1 and RCVR2). Note the true range is approximately 1.2 meters).

a) Compare the position difference between the 2 Novatels Receivers (over time). What is the range error (mean and standard deviation) between the two receivers
b) Compute the code DGPS solution (i.e. pseudorange based) between the two receivers. What is the range error (mean and standard deviation) between the two receivers.
c) Compute the carrier smoothed code DGPS solution between the two receivers. What smoothing window did you use? What is the range error (mean and standard deviation) between the two receivers.
d) ***(Bonus/Optional)*** Compute the RTK DGPS solution (i.e. carrier based) between the two receivers. You may choose to do a widelaned approach, use the Lamda method, or simply hand solve for the integers. What is the range error (mean and standard deviation) between the two receivers.
e) Determine the attitude (azimuth only is fine) from the first antenna to the second antenna. Compare this to GPS course measurement (you may need to rotate the azimuth estimate by a fixed bias to get the 2 measurements in the same frame).
f) Compute the DGPS solution from base Novatel (RCVRT) to the dynamic Novatel receiver (RCVR1). State what kind of DGPS you performed (code only, carrier smoothed code, RTK). Plot the position solution on google earth and compare to the stand alone position from the prior lab.

# Part IV: LAAS DGPS Positioning

For this part, you will need the data from one static antenna (RCVR0 or RCVRT) and one dynamic Novatel receivers (i.e. RCVR1 or RCVR2).

a) Compute the DGPS solution from base receiver (RCVR0 or RCVRT) to the dynamic Novatel receiver (RCVR1 or RCVR2). I recommend RCVRT and RCVR1. State what kind of DGPS you performed (code only, carrier smoothed code, RTK). Plot the position solution on google earth and compare to the stand alone position from the prior lab.

# Part V: WAAS DGPS Positioning (Optional/Bonus)

Download data from the CORE differential station ALA1 (website is given on the class website) measurements for January 26, 2022 for use in computing a WAAS DGPS Solution

a) Compute a corrected global differential solution for the static receiver (RCVR0 or RCVRT). State what kind of DGPS you performed (code only, carrier smoothed code, RTK). Plot the solution(s) on google earth and comment on how the position compares to the stand alone GPS solution as well as the improved solutions from Part 1?
b) Repeat for the dynamic receiver (RCVR1).