Kinematics Lab –1

Lab work 1: Control of an automatic total

Group -8

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Lab-1 Control of an automatic total station

In the first exercise we are setting up the total station and prism connection. The instruments we are using is TS30 and Leica Nova MS50 with an aid of Geo-COM. We can connect the with two different pot as it was available in the Lab. The ASCII code is established between computer and TS30. The Lab coordinator has provided a MATLAB code and we have to set up the code according to mention in the exercise as below:

-Monitoring of the instruments and prism

-Automatic start up and start a tracking prism

The matlab code is used for storing value

"No" is a counting number of the
measurements [/],

"Hz" is the horizontal direction [gon],

"V" is a vertical angle [gon],

"S" is the slope distance [m] and

"t" is the time of the slope distance measurement [seconds].

After entering the code we have to set the proper parameters of the code so that both instruments and prism are get connected.

Set up all relevant parameters as well as in the equipment (temperature, air pressure, prism, ATR, etc.).

- Setting the status of the ATR mode:
"SetUserAtrState".

- Set EDM mode:
"SetEdmMode".

- Active lock mode:
"SetUserLockState".

- Target tracking:
"LockIn".

- Carry out a distance measurement:
"DoMeasure".

- Get measurements we are getting data measured:
"GetFullMeas".

- Parse the response strings.

- Plot measurements and save data.

So, we are now ready to use code for the further exercise2.

We have done connection by using the manual and see the value and rewrite in MATLAB.

1- We are setting up the port – COM30

2-Baudrate – 115200

3-Parity – none

4-Stop Bits –1

5- Datbits
8-6-IP_Address = '192.168.254.3';

7-TCP_IP_Port =
1212;

8- setting edm measurement modes

```
request = ['%R1Q,2020:7' char(13) char(10)]; % build string
fwrite(ConObj,request,'char');
response = fscanf(ConObj);
```

We are switch on the edm and automatic targeting takes place

```
request=['%R1Q,18005:1', char(13),char(10)];

fwrite(ConObj,request,'char');

response = fscanf(ConObj);
```

We are locking the prism and measuring instruments

```
request=['%R1Q,18007:1', char(13),char(10)];

fwrite(ConObj,request,'char');

response = fscanf(ConObj);
```

We are start recording the data

```
request=['%R1Q,9013:',char(13)];

fwrite(ConObj,request,'char');

response = fscanf(ConObj)
```

Hence above data is set up in the provided MATLAB file. We have done 15 changes as mention above in the sentences. We have use manual for the above prupose and we have put value from the manual. Above task and exercise is perform under the guidance of

Mohammad Omidalizarandi.

Lab-2 : Synchronization of angle and distance measurements of a total station

Introduction - In the 2 exercise we are tracking the one-point object. Here we have to minimize error. We have to calculatelatency time. If the true position of the object is different from the mention with the help of coordinate, we can obtain the true position. We have used Leica Nova

MS50 to perform the above mentioned task standard prism. One can obtain the latency time in lecture chapter-2 as mention.

In Lab-1 we have set up the connection between station and computer. So now we will use Geo com command.

fopen/fclose = to set up the connection fwrite= to send the command in ASCII fscanf = get signal

The vehicle is moving forward and we are just obtaining the distance from the each and every point and when it comes backwards same also. The value of the prism is provided as some constant as we have different constant for different prism.

The tracking are as :- 1-IR

tracking

2-Synchronous tracking

Calculation :

We have to calculated the y axis and velocity of respected time.

$$Y^R_{\alpha,i} - Y^F_{\alpha,i} \approx 2 * V_i * \Delta t_{\alpha,S} * \cos(a^F_{i,\alpha}) * \sin(\zeta_i) * \sin(\alpha_i)$$

We are having Y axis for reverse and forward as respectively. V is the velocity at time t. S is slope distance. apha is the vertical angle eta is the horizontal angle. We have to find the specific time for the forward and backward which match the data forward and same for the backward point. Angle and the time measurement are done with forward and backward point with the help of horizontal angle. Euclidian distance have to calculated with two matching point forward and backward. We have 3 position where prism stop are as :

1- Starting point

2- Middle of the path and

3- End of the path

so if have to put he prism has to keep moving then we have keep moving so we have to deleted all above 3 points. We have to calculate distance where is the coordinate is known. We might get some true position and some withpseudo.

points. The equation are as below:-

(2) $$Y_{\alpha,i} = Y_T + S_i \ * \sin(\alpha_i) * \sin(\zeta_i)$$

(3) $$X_{\alpha,i} = X_T + S_i \ * \cos(\alpha_i) * \sin(\zeta_i)$$

(4) $$Z_{\alpha,i} = Z_T + S_i \ * \cos(\zeta_i)$$

Here X_T ,Y_T and Z_T are the coordinate of the tachymeter. The Si is the distance at point i for alpha and delta for the horizontal and vertical. We will going to calculation of the neighbour points for the obtaining velocity. We have set threshold 0,02. We have to calculation distance by equation are as below:-

$$D_i = \sqrt{(X_{i,\alpha} - X_{i-1,\alpha})^2 + (Y_{i,\alpha} - Y_{i-1,\alpha})^2 + (Z_{i,\alpha} - Z_{i-1,\alpha})^2}$$

By knowing distance we will going to calculate velocity for each and every point of the with below equation are as :-

$$V_i = \frac{D_{i+1,\alpha} + D_{i,\alpha}}{t_{i+1,\alpha} + t_{i-1,\alpha}}$$

$$t_{P_{s,i},P_{\alpha,i}} = \operatorname{atan}\left(\frac{Y_{P_{\alpha,i+1}} - Y_{P_{\alpha,i-1}}}{X_{P_{\alpha,i+1}} - X_{P_{\alpha,i-1}}}\right)$$

$$\zeta_{P_{s,i},P_{\alpha,i}} = \operatorname{acos}\left(\frac{Z_{P_{\alpha,i+1}} - Z_{P_{\alpha,i-1}}}{D_{i+1,\alpha} + D_{i,\alpha}}\right)$$

The angles are calculated for the using false coordinate.

$$\cos(a^{F}_{i,\alpha}) = \cos\left(\zeta_{P_{s,i},P_{\alpha,i}}\right)^{*}\cos(\zeta_i) + \sin\left(\zeta_{P_{s,i},P_{\alpha,i}}\right)^{*}\sin(\zeta_i)^{*}\cos\left(t_{P_{s,i},P_{\alpha,i}} - \alpha_i\right)$$

We have to calculate cos(alpha)as above. We have to calculate latency time with each iteration. We have to calculate unknown distance measurement are as

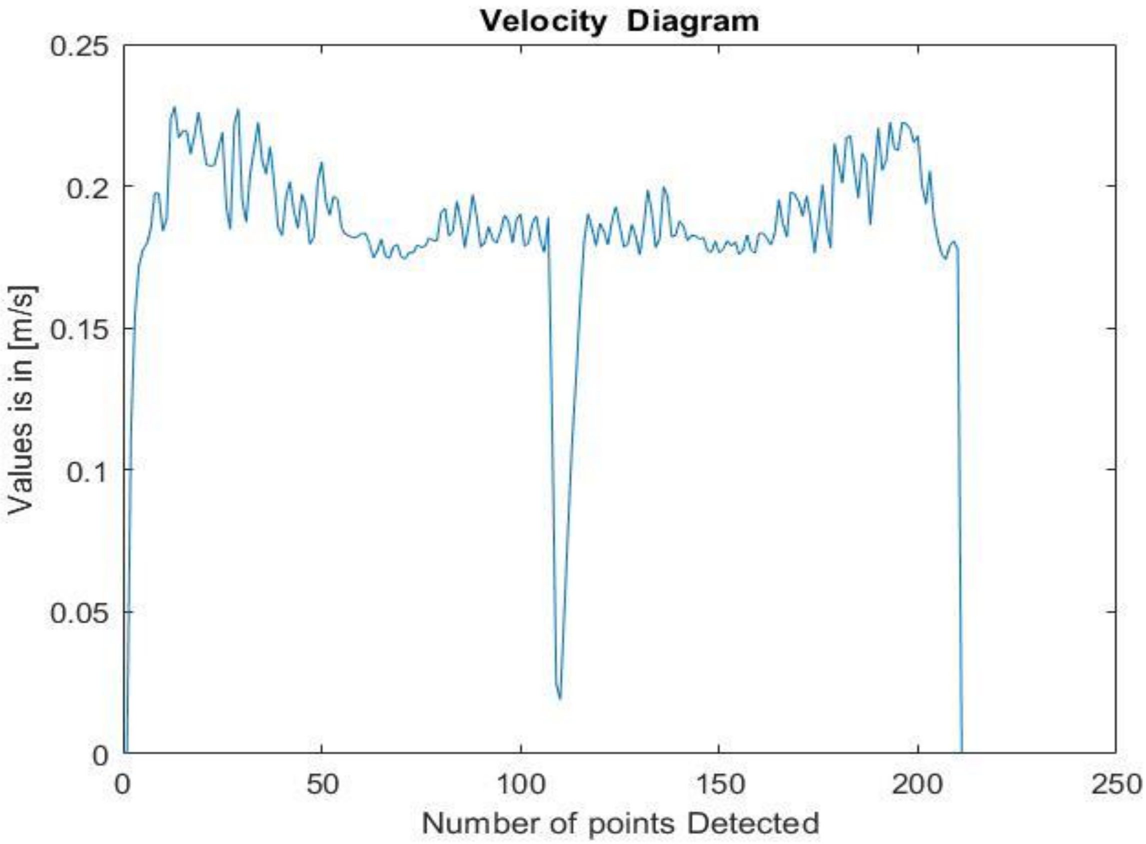
$$S_{i,\alpha} - S_i \approx \Delta S_i * \cos\left(a_{i,\alpha}\right) - \frac{1}{2}\frac{\Delta S_i{}^2}{S_i} * sin^{-1}(a_{i,\alpha})$$

we will going to calculate for the coordinate are as :-

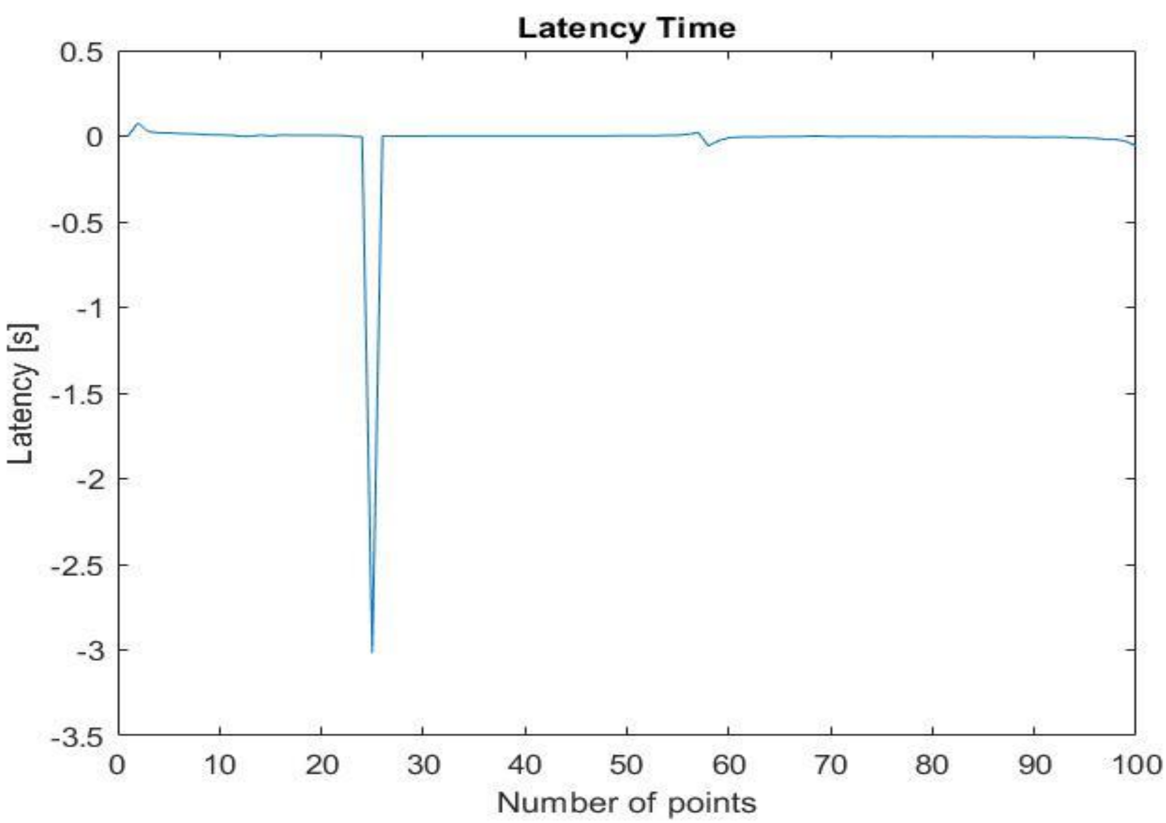
$$Y_{\alpha,i} = Y_{\alpha,i}{}' + (S_{i,\alpha} - S_i) * \sin(\alpha_i) * \sin(\zeta_i)$$
$$X_{\alpha,i} = X_{\alpha,i}{}' + (S_{i,\alpha} - S_i) * \cos(\alpha_i) * \sin(\zeta_i)$$
$$Z_{\alpha,i} = Z_{\alpha,i}{}' + (S_{i,\alpha} - S_i) * \cos(\zeta_i)$$

Result and Conclusion:-

The velocity diagram shown as below :-



The graph is showing latency time versus all points.



The latency time diagram shown above as we are having some outlires and after removing outliers we are getting the latency time are as :-

mean_t_latency	0.0310
mean_velocity	0.1850

t latency=0.0310 sec
Velocity = 0.1850 m/sec

As we have doing some of the data and analysis.

1- What is the latency time?
The time difference between two measuring value. Here we are having moving robot and one is stationary measuring Geocom. So when the distance is measuring at time t1 and then angle is measure at time t2 so difference between distance and angle measuring time is known as latency time. Latency time=t1-t2. Both are measured so fast but difference between time is in sec.

2- What is the statistic?
The statics of the calculation is to find the difference between two time of measuring distance and angle.

3- Provide the all calculation equation?
All equation are mention above and we have taken all equation chap1 and chap2.

Here we have set up 0,9gon. We are setting up theextreme angle. There is the acceleration and deceleration at the beginning and ending.

Here we have find the latency time against all points. Hence we have find out that the latency time difference is the time between real position and moved position. It shows if we have the time difference and the angle then we can obtain exact position of the object or the targeting object. Hence such method is used in civilengineering, tracking, etc. Thus with the above calculation we can obtain real position as seen above.Hence we have latency time for the both of the processas tracking . Thus we can obtain exact position of the respected object.