

ECE 4310/6310 Introduction to Computer Vision

Lab #7 – Motion Tracking

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We are looking for movement in any of the axis with respect to the variance. For this we have a specified window which will give us the variance of the that window and check if it's above the threshold. If yes, we calculate the gyroscope reading by multiplying it by the time to see the rotation with respect to each axis. For accelerometer I have taken to take the average of the velocity of the previous a new velocity with respect. To read velocity of each axis we multiple it by the gravity and the time and take the average. For some axis it was easy to calculate cause there was no movement in that axis.

The below table shows the threshold of gyro and Accelerometer data with the window used to take the variance. The rotation is in radians and the distance is in meters. We can take an example below for the first period the rotation was minimal as in not that significant. But the most noticeable movement was in Z axis for the acceleration was in -26. which means it's around 26m in one direction. Each value is the average rotation and velocity in that period. That total distance and the rotation is calculated at the end of it. I have used multiple windows and thresholds and the output is given below.

Accelerometer Threshold - 0.000900					GyroScope Threshold - 0.030000Window - 10						
					Rotation			Distance Moved			
Start Index	End Index	Period Length	Start Time	End Time	Pitch [Radian]	Roll[Radian]	yaw[Radian]	Distance X	Distance Y	Distance Z	
14	48	34	0.7	2.4	-0.001847	-0.000705	-0.002613	0.242882	-0.313148	-14.01006	
109	141	32	5.45	7.05	-0.001717	-0.000214	-0.0135	0.057237	0.53329	-12.414348	
205	237	32	10.25	11.85	0.000165	0.000641	-0.00646	-0.217162	0.081988	-12.399937	
286	312	26	14.3	15.6	-0.001373	0.003339	0.003291	0.306143	-0.000505	-8.185588	
313	328	15	15.65	16.4	0.000143	-0.005484	-0.004347	-0.06246	-0.003031	-2.725714	
378	407	29	18.9	20.35	-0.001069	-0.004713	-0.008636	0.359972	-0.054766	-10.64872	
448	487	39	22.4	24.35	0.003103	0.001435	-0.00069	3.056256	-1.637123	-17.661589	
622	662	40	31.1	33.1	-0.000169	-0.00048	0.026045	-0.104642	-0.106179	-19.392607	
741	774	33	37.05	38.7	0.000421	-0.001378	-0.029888	-0.13283	0.117453	-13.269423	
854	888	34	42.7	44.4	0.038738	0.001531	-0.004966	-0.659122	-4.135501	-11.766035	
956	990	34	47.8	49.5	-0.035775	0.004706	0.003697	-0.551448	-12.606754	-2.955155	
1059	1087	28	52.95	54.35	0.00059	0.03949	0.002606	2.599399	-0.017509	-8.314718	
1158	1194	36	57.9	59.7	0.009559	0.043791	-0.009173	14.105116	-0.017829	-2.897318	
				Total	0.010769	0.081959	-0.044634	18.999341	-18.159614	-136.641212	
Accelerometer Threshold - 0.000900					GyroScope Threshold - 0.030000Window - 20						
					Rotation			Distance Moved			
Start Index	End Index	Period Length	Start Time	End Time	Pitch [Radian]	Roll[Radian]	yaw[Radian]	Distance X	Distance Y	Distance Z	
5	47	42	0.25	2.35	-0.002419	-0.000936	-0.00175	0.352533	-0.309568	-21.381294	
99	141	42	4.95	7.05	-0.001717	-0.000214	-0.0135	0.191492	0.578579	-21.376095	
196	236	40	9.8	11.8	0.00097	0.001649	-0.006909	-0.150589	0.105197	-19.386427	
276	328	52	13.8	16.4	0.000143	-0.005484	-0.004347	0.68473	0.018411	-32.78159	
368	406	38	18.4	20.3	0.014627	-0.013555	0.004444	0.434299	-0.003757	-17.976664	
439	484	45	21.95	24.2	0.0056	-0.007801	-0.002611	3.981427	-2.823389	-23.638948	
612	660	48	30.6	33	-0.000471	0.002454	0.028153	-0.00152	-0.075387	-27.943727	
732	773	41	36.6	38.65	0.000224	-0.000699	-0.027106	-0.139125	0.087022	-20.451683	
844	888	44	42.2	44.4	0.038738	0.001531	-0.004966	-0.641987	-4.129016	-21.22555	
946	990	44	47.3	49.5	-0.035775	0.004706	0.003697	-0.909985	-22.07081	-2.855779	
1049	1087	38	52.45	54.35	0.00059	0.03949	0.002606	2.612689	-0.019962	-16.336426	
1149	1194	45	57.45	59.7	0.009559	0.043791	-0.009173	23.02113	-0.03924	-1.887527	
				Total	0.030069	0.064932	-0.031462	29.435094	-28.68192	-227.24171	

Accelerometer Threshold - 0.003000 GyroScope Threshold - 0.005000 Window - 10										
					Rotation			Distance Moved		
Start Index	End Index	Period Length	Start Time	End Time	Pitch [Radian]	Roll[Radian]	yaw[Radian]	Distance X	Distance Y	Distance Z
15	52	37	0.75	2.6	0.004835	-0.003716	0.012032	0.295611	-0.289576	-16.590498
109	142	33	5.45	7.1	-0.002457	-0.001084	-0.010909	0.061429	0.543403	-13.20223
210	235	25	10.5	11.75	0.000944	-0.000641	-0.003633	-0.234212	0.066188	-7.564683
287	315	28	14.35	15.75	-0.001131	-0.003486	-0.001049	0.37255	-0.006638	-9.49174
318	324	6	15.9	16.2	0.000829	0.000212	0.007546	-0.011157	-0.000605	-0.435643
379	406	27	18.95	20.3	0.014627	-0.013555	0.004444	0.308397	-0.038471	-9.288068
450	491	41	22.5	24.55	-0.001315	-0.01032	0.002881	3.254442	-1.526821	-19.558229
619	667	48	30.95	33.35	-0.000432	0.000298	0.013096	-0.138392	-0.126533	-27.931917
740	776	36	37	38.8	-0.000409	-0.000033	-0.012584	-0.133697	0.13023	-15.794689
853	892	39	42.65	44.6	0.00746	0.00162	-0.003114	-0.834792	-6.057235	-14.746711
921	926	5	46.05	46.3	0.004966	0.000105	0.001259	-0.010705	-0.303308	0.002854
954	994	40	47.7	49.7	-0.009174	0.015642	-0.015088	-0.782813	-16.904068	-4.581918
1055	1091	36	52.75	54.55	-0.000094	-0.006766	-0.000363	4.155426	-0.024443	-13.399473
1156	1194	38	57.8	59.7	0.009559	0.043791	-0.009173	15.913594	-0.019535	-2.697882
				Total	0.028208	0.022067	-0.014655	22.215681	-24.557412	-155.280827

Accelerometer Threshold - 0.003000GyroScope Threshold - 0.005000Window - 20											
					Rotation			Distance Moved			
Start Index	End Index	Period Length	Start Time	End Time	Pitch [Radian]	Roll[Radian]	yaw[Radian]	Distance X	Distance Y	Distance Z	
8	46	38	0.4	2.3	-0.001402	-0.000276	-0.00787	0.292061	-0.312714	-17.50115	
100	141	41	5	7.05	-0.001717	-0.000214	-0.0135	0.175449	0.576918	-20.371506	
204	233	29	10.2	11.65	0.000759	-0.001843	0.028291	-0.194758	0.062581	-10.18876	
281	310	29	14.05	15.5	-0.000468	0.007965	0.00131	0.28295	0.014394	-10.191627	
369	406	37	18.45	20.3	0.014627	-0.013555	0.004444	0.418623	-0.008752	-17.059153	
440	488	48	22	24.4	0.002804	-0.022084	-0.00264	4.500333	-2.987023	-26.980602	
610	666	56	30.5	33.3	0.00005	-0.00172	0.020195	-0.025485	-0.090392	-38.048302	
731	775	44	36.55	38.75	-0.000835	-0.000711	-0.021732	-0.139676	0.097026	-23.556107	
843	891	48	42.15	44.55	0.009086	0.004466	0.002127	-0.770692	-5.529834	-24.646173	
944	994	50	47.2	49.7	-0.009174	0.015642	-0.015088	-1.190521	-27.819666	-4.467631	
1046	1088	42	52.3	54.4	0.007666	-0.008664	-0.000858	2.968529	-0.017533	-19.98514	
1147	1194	47	57.35	59.7	0.009559	0.043791	-0.009173	25.271969	-0.047436	-1.604338	
				Total	0.030955	0.022797	-0.014494	31.588782	-36.062431	-214.600489	

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <stdint.h>
```

```
#include <string.h>
```

```
#include <math.h>
```

```
#define AccThreshold 0.003
```

```
#define GyroThreshold 0.005
```

```
#define Gravity 9.81
```

```
#define sample_windowtime 0.05
```

```
void smooth(int Smooth_window,int size,float *raw,float *smooth){
```

```
    double sum=0;
```

```

    for (int i = 0; i < sample_windowtime; i++){
        smooth[i] = raw[i];
    }
    for (int i = sample_windowtime - 1; i < size; i++){
        for (int j = 1; j < sample_windowtime; j++){
            sum += raw[i-j];
        }
        smooth[i] = (sum+raw[i]) / sample_windowtime;
        sum = 0;
    }
}

float Var(float *smooth, int index,int window){
    float variance=0;
    float mean=0;
    float total=0;
    for(int i=index;i<index+window;i++){

        total=smooth[i]+total;
    }
    mean =total/window;
    for(int i=index;i<index+window;i++){
        variance=variance+pow((smooth[i]-mean),2);
    }
    variance=(variance/(window-1));
    return variance;
}

int main ()
{
    FILE *ftr,*ftr1;
    char * line = NULL;
    size_t len = 0;

```

```

ssize_t read;

ftr=fopen("acc_gyro.txt","r");

int size=1250;

float *time,*x_acc,*y_acc,*z_acc,*pitch,*roll,*yaw;

float *Smooth_x_acc,*Smooth_y_acc,*Smooth_z_acc,*Smooth_pitch,*Smooth_roll,*Smooth_yaw;

int window=10;

time=(float *)calloc(size,sizeof(float));

x_acc=(float *)calloc(size,sizeof(float));

y_acc=(float *)calloc(size,sizeof(float));

z_acc=(float *)calloc(size,sizeof(float));

pitch=(float *)calloc(size,sizeof(float));

roll=(float *)calloc(size,sizeof(float));

yaw=(float *)calloc(size,sizeof(float));

///Smooth

Smooth_x_acc=(float *)calloc(size,sizeof(float));

Smooth_y_acc=(float *)calloc(size,sizeof(float));

Smooth_z_acc=(float *)calloc(size,sizeof(float));

Smooth_pitch=(float *)calloc(size,sizeof(float));

Smooth_roll=(float *)calloc(size,sizeof(float));

Smooth_yaw=(float *)calloc(size,sizeof(float));

float *Acc_movement,*gyro_movement;

    float *vel,*total;

    total=(float *)calloc(6,sizeof(float));

    //Read Contour Points

    int File_size=0;

    read = getline(&line, &len, ftr);

    while ((read = getline(&line, &len, ftr)) != -1){

        sscanf( line, "%f %f %f %f %f %f %f\n",

&time[File_size],&x_acc[File_size],&y_acc[File_size],&z_acc[File_size],&pitch[File_size],&roll[File_size],&yaw[File_size]);

        File_size++;

    }

```

```

///Smoothing

smooth(window,size,x_acc,Smooth_x_acc);
smooth(window,size,y_acc,Smooth_y_acc);
smooth(window,size,z_acc,Smooth_z_acc);
smooth(window,size,pitch,Smooth_pitch);
smooth(window,size,roll,Smooth_roll);
smooth(window,size,yaw,Smooth_yaw);


ftr=fopen("Smooth.txt","w");
for(int i=0;i<File_size;i++){
    fprintf(ftr,"%f %f %f %f %f
%f\n",Smooth_x_acc[i],Smooth_y_acc[i],Smooth_z_acc[i],Smooth_pitch[i],Smooth_roll[i],Smooth_yaw[i]);
}

ftr=fopen("TotalData.txt","w");
ftr1=fopen("event.txt","w");


while(window<=50){
    fprintf(ftr1,"Accelerometer Threshold - %f    GyroScope Threshold - %f    Window - %d
\n",AccThreshold,GyroThreshold,window);
    total=(float *)calloc(6,sizeof(float));
    int moving_now=0;
    int Start=-1;
    int end=-1;
    float Now_time;

    for(int i=0;i<File_size;i++){
        ////reload

        vel=(float *)calloc(3,sizeof(float));
        Acc_movement=(float *)calloc(3,sizeof(float));
    }
}

```

```

gyro_movement=(float *)calloc(3,sizeof(float));

    Now_time=time[i];

    float Var_xacc=Var(x_acc,i>window);
    float Var_yacc=Var(y_acc,i>window);
    float Var_zacc=Var(z_acc,i>window);
    float Var_pitch=Var(pitch,i>window);
    float Var_roll=Var(roll,i>window);
    float Var_yaw=Var(yaw,i>window);

//Check if in Rest
    if(Var_xacc>AccThreshold || Var_yacc>AccThreshold || Var_zacc>AccThreshold){
        moving_now=1;
    }
    if(Var_pitch>GyroThreshold || Var_roll>GyroThreshold || Var_yaw>GyroThreshold){
        moving_now=1;

    }
    if(Start==-1 && moving_now==1){
        Start=i;
    }
    if(Start!=-1 && moving_now==0){
        end=i;
    }
    if((i+1==File_size) && (Start!=-1 && moving_now==1))end=i;

    if(Start>=0 && end>0 && moving_now==0){

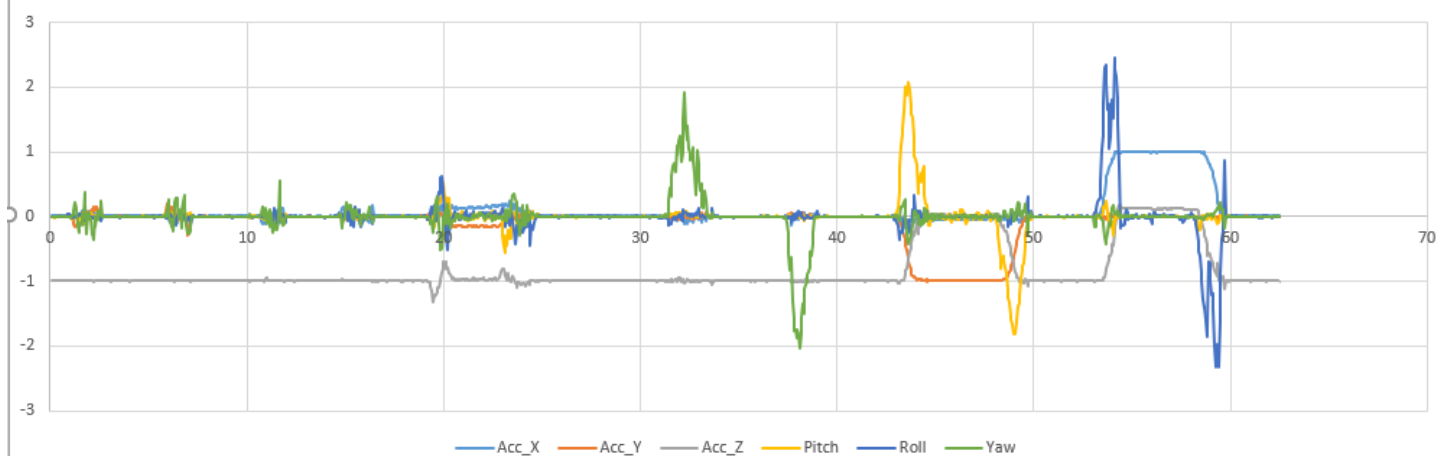
    ///acc
        for(int i=Start;i<end;i++){
            gyro_movement[0]=pitch[i]*sample_windowtime;
            gyro_movement[1]=roll[i]*sample_windowtime;
            gyro_movement[2]=yaw[i]*sample_windowtime;

```



```
fprintf(ftr,"%d %f %f %f %f %f %f\n",i,gyro_movement[0],gyro_movement[1],gyro_movement[2],Acc_movement[0],Acc_movement[1],Acc_movement[2]);  
  
    }  
  
        moving_now=0;  
  
}////Main For  
fprintf(ftr1,"%d %d %d %f %f %f %f %f %f %f %f %f\n",Start,end,(end-Start),time[Start],time[end],total[0],total[1],total[2],total[3],total[4],total[5]);  
  
fprintf(ftr1,"----- \n");  
fprintf(ftr1,"----- \n");  
  
        window+=10;  
  
}////while  
  
}
```


Raw Data



Smooth Data

