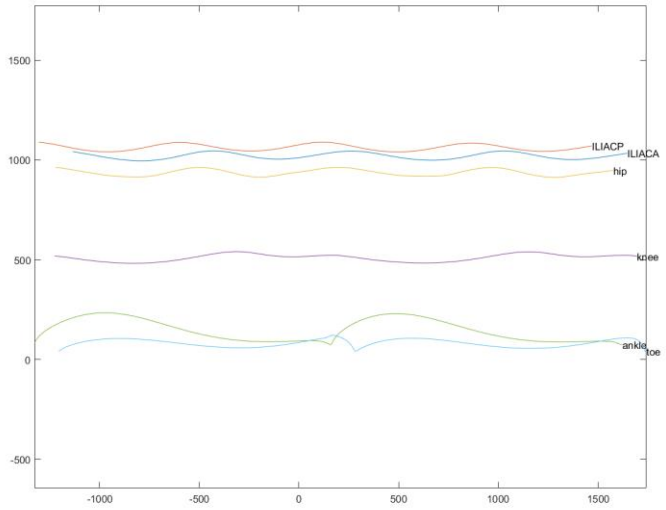
DEPARTMENT OF ELECTRONIC AND TELECOMMUNICATION ENGINEERING,
FACULTY OF ENGINEERING,
UNIVERSITY OF MORATUWA.

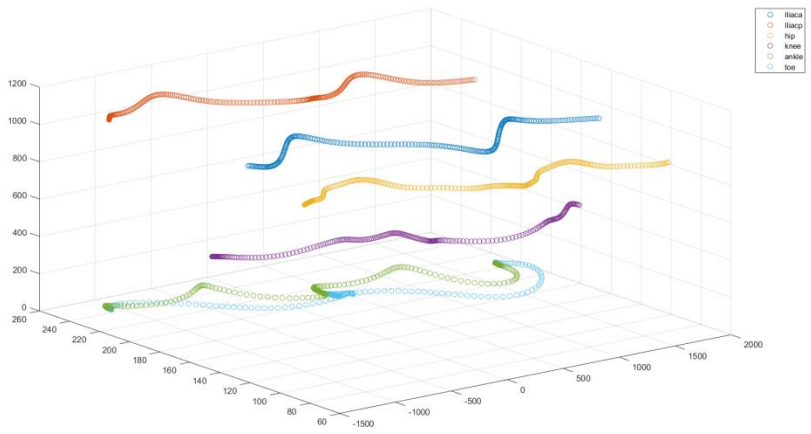
Course	*BSc Eng (Hons)*	**Session**	*Semester 8 – 18 batch*
Module Code	*BM4500*	**Module Title**	*Biomechanics*
Practical No.	*P3*	**Practical Name**	*Gait analysis- instrumentation and data processing*
Practical Coordinator	*Ms. D.D. Pasqual*	**Facilitator(s)**	*Ms. D.D. Pasqual* *Mr. H.M.J. De Silva*
Student Index No.	*180066F*	**Student Name:**	*Nuwan Bandara*

1. Load the relevant marker data into Matlab.

2. Plot and label the marker trajectories in the sagittal (xz) plane. Use the Matlab command axis(„equal") to get the same scaling in each dimension.

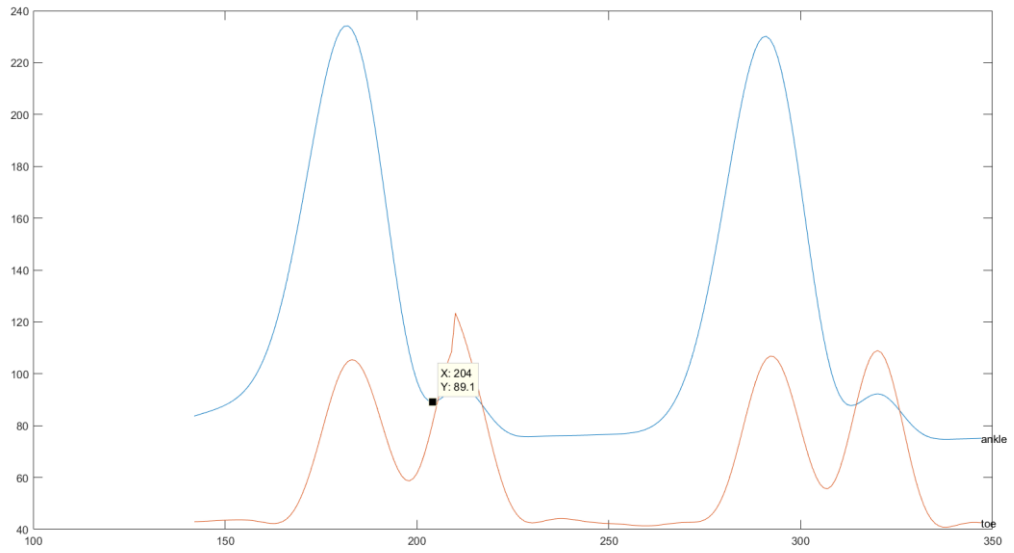


3. Use scatter3 command to visualize the markers movement in 3D frame w.r.t. time.

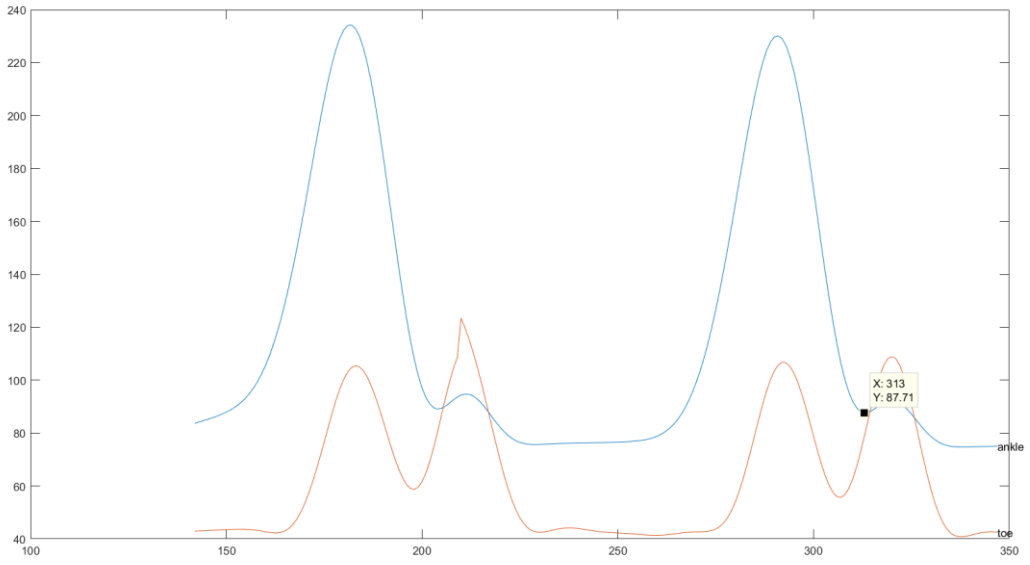


4. Define the gait cycle using markers, Follow the procedure below:

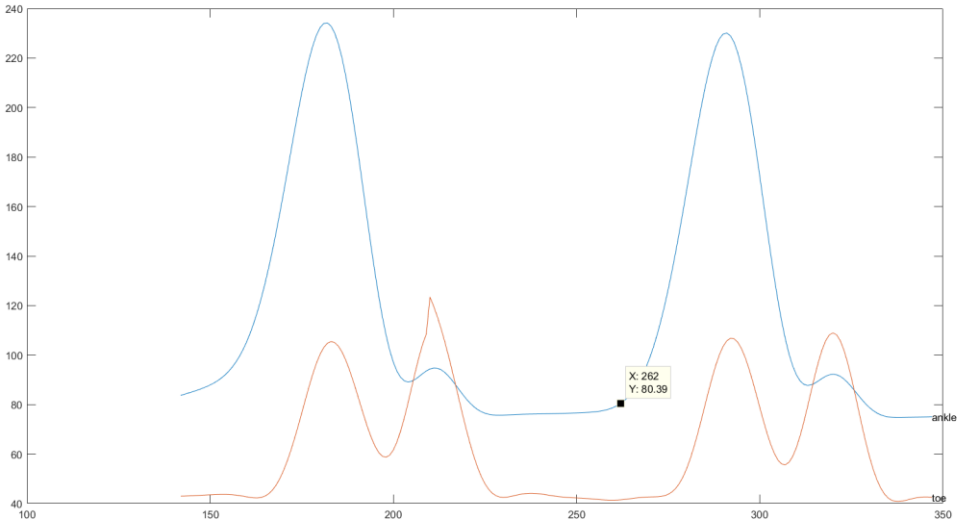
   a. Plot the vertical components (z) of the marker trajectories of the lateral malleolus (ankle) marker and the toe marker versus data point number. Identify and label the points at which heel strike (HS), foot flat (FF), heel off (HO), and toe off (TO) occur.
   HS – [204 sample, 89.1 z], [313 sample, 87.71 z]
   FF – [260 sample, 41.36 z]
   HO – [262 sample, 80.39 z]
   TO – [274 sample, 43.16 z]



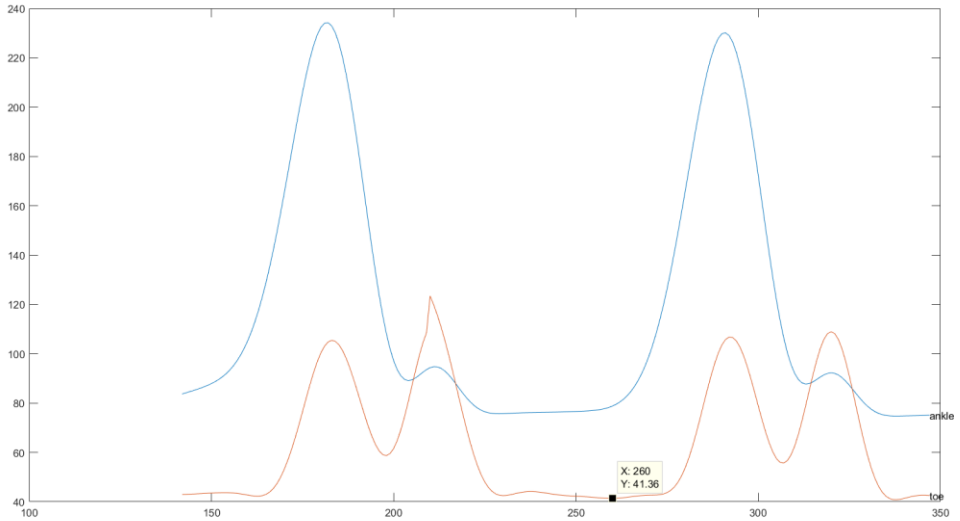
Heal strike -1



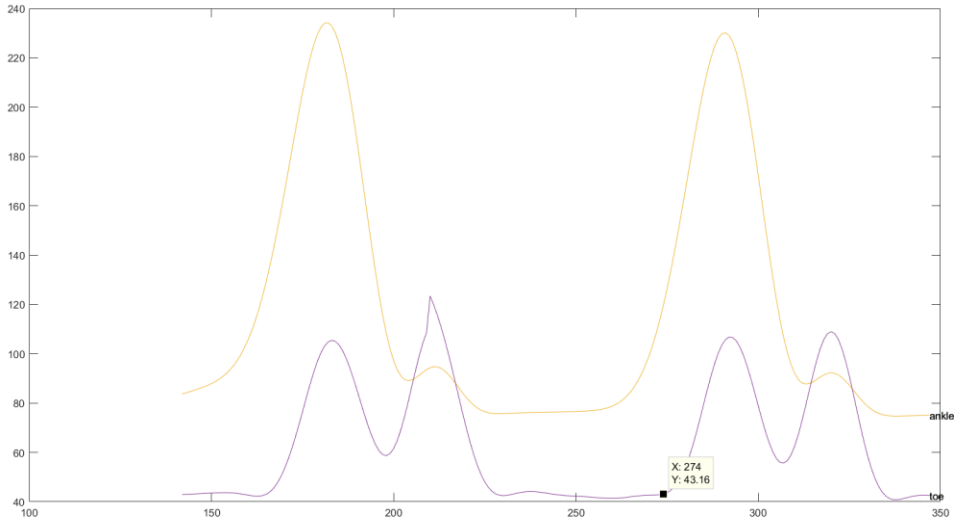
Heal strike - 2



Heal off



Foot flat



Toe off

b. Complete the following table:

	From the marker data
Heel strikes (Consecutive 2 heel strikes) (data point numbers)	204, 313 samples
Toe-off (data point number)	274 sample
Time for one gait cycle (seconds)	313-204 = 109 samples; Sampling rate = 100 samples/second Therefore, one gait cycle = 1.09 seconds
Time for stance phase (seconds)	274-204 = 70 samples; Sampling rate = 100 samples/second Therefore, stance phase = 0.7 seconds
Time for swing phase (seconds)	313 – 274 = 39 samples; Sampling rate = 100 samples/second Therefore, swing phase = 0.39 seconds
Stance phase (% gait cycle)	$\frac{0.7\ seconds}{1.09\ seconds} = 64.22\%$
Swing phase (% gait cycle)	$\frac{0.39\ seconds}{1.09\ seconds} = 35.78\%$
Comment on the results	The stance phases and swing phases are nearly close to the typical values of 60% and 40% respectively, even though they are not exactly the same. Therefore, the gait cycle seems to be normal in that aspect.

5. Using the data and plots of marker positions, complete the table below. Include any calculations in the space provided, along with a note of which markers you are considering.

Stride length (m)	In regard to the x coordinates of the sampling points of 204,313: 1308-(-154.1) = 1462.1mm =1.4621m
Cadence (steps/min)	One gait cycle: $1.09 \div 60\ minutes = 0.01814\ minutes$ Cadence: $\frac{2}{0.01814} = 110.254\ steps/min$
Avg velocity of progression (m/s) [Consider the movement in the x-direction of a marker close to the body"s centre of mass].	$Stride\ length = \frac{1308-(-154.1)}{1000}\ m = 1.4621m$ $Average\ velocity = \frac{1.4621m}{1.09seconds} = 1.3414\ m/s$

6. Calculate the instantaneous velocity of progression, and plot this versus data point number (time). How does the result compare with the average velocity of progression?

7. Calculate the length of the thigh segment in 2D (xz) and 3D (xyz), and plot this versus data point number. Why are the segment lengths not constant?

8. Calculate the knee joint angle in 2D. Plot this either versus data point number and indicate when heel strike and toe-off occur. Compare this plot to the „normal" knee joint angle data.

Assessment

Complete a coursework using the following guideline and submit on next practical class date.

- Introduction – short description of the human gait cycle and the importance of its study.*(1/2 Page)*
- Methods – short description of how kinematic (marker) data and ground reaction force during level walking is measured, along with how the data (markers data) was processed using Matlab. *(1.5page)*
- Results – refer to the tables and graphs from the data processing part of the lab
- Discussion of results –comment on definition of heel strike and toe-off using marker data; comment on where there might be errors in the measurements of the given data set.
- Conclusions – what new knowledge acquired from the lab session, and areas you further expect from the lab session.