ME/BIOE 481: Whole body biomechanics

Assignment 1: Engineering review and anatomical conventions

1 Critical info

- Due date: February 5, 2021 - 1PM (US Central standard time)
- Part 1: 10 points; Part 2: 10 points
- This is an individual section of the assignment. See instructions below.
- Part 2: You may work in pairs. Include your names at the top of the assignment. You and your partner will receive the same grade. Only one person needs to turn in the assignment to compass. It can be neatly handwritten or typed. Let the pride in your work show in the quality/legibility of the assignment you turn in. Illegible writing or poor scans/uploads will not be graded.
- Show all work!

2 Objectives

The objectives of this assignment are to:

- help refresh your memory on engineering fundamentals with regards to statics and dynamics and
- assess your understanding of anatomical conventions
- assess your understanding of center of gravity measurements

3 Background

In this course, we will be using principles from statics, dynamics, solid mechanics and dynamic systems to understand whole body biomechanics. This involves understand how to assess vector quantities like position, velocity, accelerations, forces, and moments and applying them to various scenarios using free body diagrams.

You can find an excellent refresher of these principles at the TAM 2XX web page: http://mechref.engr.illinois.edu/index.html.

Course-specific questions in this assignment (Objective 2) are based on lecture materials and references posted on the course website:

https://courses.grainger.illinois.edu/me481/sp2021/sched.html.

4 Part 1: Vector mathematics review

1. Go to https://www.prairielearn.org and enroll in 481 - Spring 2021
2. Complete HW 1

5 Part 2: Anatomical conventions and center of gravity

Name: _____

Name: _____

1. Define the following terms in your own words: (0.5 points each)
   (a) biomechanics
   (b) kinetics
   (c) kinematics

2. Draw profiles (stick diagrams are fine) of a human in the sagittal, frontal, and transverse planes. Label each plane in your drawings and anatomical direction vectors. For example, Figure 1 is a profile of a tiger in the sagittal plane. (0.5 points/cartoon).

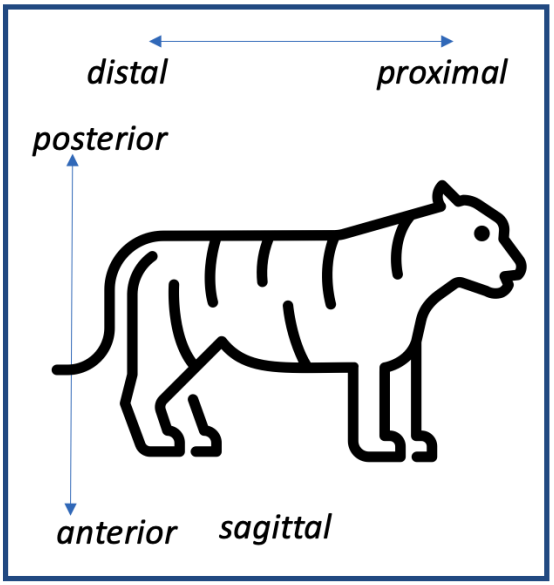

Figure 1

3. Consider a cyclist as shown in Figure 2 and given the following angles:

   $\alpha = 45°$ $\beta = 130°$ $\theta = 30°$

   L = ankle malleolus, K = knee, H = hip, S = shoulder, E = elbow, W = wrist

   Anthropometric tables are available on the course website - Lecture 3:

   https://courses.grainger.illinois.edu/me481/sp2021/sched.html

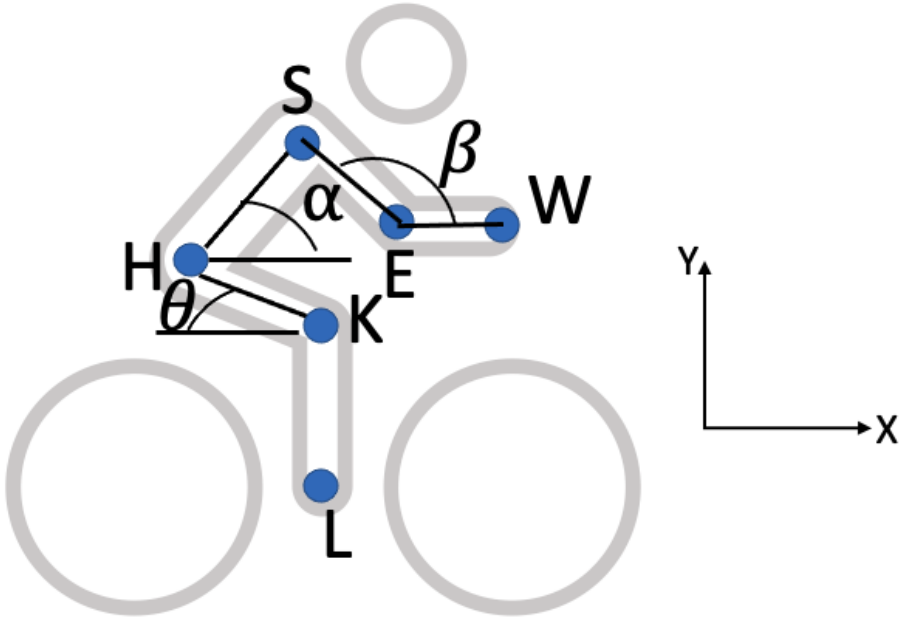

Figure 2

(a) Using the hip as the origin and assuming you are the cyclist (i.e. height = your height). Calculate the location of the center of gravity of each segment (ignore the head). Indicate which anthropometric table you used and any assumptions made.

Show all work and write your finals answers in a table (see example below). (3 points)

Height (cm):		
Center of gravity location	X	Y
Forearm		
Upper arm		
Trunk		
Thigh		
Shank		

(b) Draw the location of the center of gravity on the diagram shown in Figure 3. (1 point)

(c) Calculate the location of the center of gravity of the entire cyclist (exclude the head) and draw it's location on the cyclist. (3 points)

Figure 3