KAAP686-17S Homework 2 (42 points)

1. (18 points) File ../reserve/matlab/walkdata20030113rtankleZ.txt contains a single column of numbers: height of ankle in mm, sampled at 120 Hz.

a. (1) What is the sampling interval, in seconds?

b. (2) Plot ankle height (y) versus time in seconds.

c. (3) Compute and plot vertical velocity versus time (vy = dy/dt). Use “Method 1” (below) to compute vy = dy/dt.

d. (3) Compute and plot vertical velocity versus time. Use “Method 2” to compute vy = dy/dt.

e. (3) Compute and plot vertical acceleration versus time (ay = d(vy)/dt). Use Method 1 and the velocity data from c. to compute ay.

f. (3) Compute and plot vertical acceleration versus time. Use Method 2 and the velocity data from d. to compute ay.

g. (3) Why do the acceleration plots in e. and f. differ from each other in the way that they do?

Provide Matlab commands or script, or Labview code, if you use Matlab or Labview to do the problem.

Remember axis titles and units.

2. (8 points) File ../reserve/treadmill\_filtering/grf\_z\_treadmill\_1khz\_1cycle.txt contains a single column of numbers: ground reaction force in Newtons, sampled at 1000 Hz. The data was collected from a subject running on a treadmill with a force plate under the belt.

a. (2) Plot the ground reaction force versus time.

b. (3) Plot the time derivative of force, dF/dt, computed with Method 1.

c. (3) Plot the time derivative of force, dF/dt, computed with Method 2.

Provide Matlab commands or script, or Labview code, if you use Matlab or Labview to do the problem.

Remember axis titles and units.

3. (16 points) File ../reserve/072561\_04\_trunc.ASC contains three columns: time (in seconds), raw EMG (in arbitrary units), and force (units not specified). This human subject data from Dr. Chris Knight includes EMG from a fine wire electrode inserted in the dorsal interosseous muscle, and the force created by voluntary isometric abduction of the index finger. (Instructor: see force\_emg\_analysis.vi, written for CAK.)

a. (2) What are the sampling interval and the sampling rate?

b. (2) Plot force versus time.

c. (3) Plot the time derivative of force, dF/dt, computed with Method 1. Hint: If you do this right, the resulting graph of dF/dt versus time will be unexpected, and you may think you made a mistake.

d. (3) Plot the time derivative of force, dF/dt, computed with Method 2. Hint: This graph also looks like there must be a mistake.

e. (3) Plot the time derivative of force, dF/dt, computed with Method 3 below. Hint: This is starting to look more reasonable.

f. (3) Why do the plots from parts c. and d. look wrong? You may find the answer by zooming in on the plot of force versus time, or by looking at the text file that has the data. What suggestions would you make to the person who collects the data or to the person who writes the program to collect the data, to fix this problem? Why does the plot from part e. (dF/dt by Method 3) look better?

Remember units and axis titles.

Method 1: dx/dt(k) = [x(k) - x(k-1)] / ΔT, where k=sample number and ΔT=sampling interval.

Method 2: dx/dt(k) = [x(k+1) - x(k-1)] / (2·ΔT)

Method 3: dx/dt(k) = [x(k+5) - x(k-5)] / (10·ΔT)

By the way: “dx/dt(k)” means the kth sample of the derivative.