

Matlab Assignments

Spring 2008

Matlab Assignment #1

due Thursday 5/15/8, by 9:10 a.m.

NO LATE ASSIGNMENTS WILL BE ACCEPTED!

Matlab Assignment #1 focuses on the forward and inverse pose kinematics of the human arm. The text is Section 3.1.2 of Dr. Bob's biomechanics notes. Use the simplified planar 3-dof human arm model where L_1 is the upper arm length, L_2 is the forearm length, L_3 is the hand length, θ_1 is the absolute shoulder pitch angle, θ_2 is the relative elbow pitch angle, and θ_3 is the relative wrist pitch angle.

Your assignment is to replicate the plots given in the notes. Choose either the adult female or adult male model, no need to do both – clearly state your choice in your memo. For both cases below, animate the simulated human arm to the screen (the FPK m-file in the notes shows you how to do this).

1. Perform **forward pose kinematics** simulation in Matlab according to the same inputs as in the notes. The Matlab program is given for you in the notes – feel free to adapt this for your m-file. Plot:

- Input angles ($\theta_1, \theta_2, \theta_3$) vs. time
- FPK results (x, y, ϕ) vs. time
- FPK results (y vs. x ; square axes with equal X, Y , ranges)
- Simulated muscle lengths (biceps and triceps) vs. time
- Initial and final arm poses (y vs. x ; square axes with equal X, Y , ranges).

2. Perform **inverse pose kinematics** simulation in Matlab according to the same inputs as in the notes. The Matlab program is not given for you in the notes, but you can modify the above m-file. Plot:

- Input Cartesian pose (x, y, ϕ) vs. time
- IPK results ($\theta_1, \theta_2, \theta_3$) vs. time
- Simulated muscle lengths (biceps and triceps) vs. time
- Initial and final arm poses (y vs. x ; square axes with equal X, Y , ranges).

The first page of your Matlab Assignment #1 report must be a one-page memo. You are expected to work with others on the concepts and Matlab strategies – however, all computer work and written work must be strictly individual. Start early and ask questions at any time – the answer key for this assignment is in the notes.

Matlab Assignment #2

due Thursday 5/22/8, by 9:10 a.m.

NO LATE ASSIGNMENTS WILL BE ACCEPTED!

Matlab Assignment #2 focuses on the pseudostatics simulation of the human elbow joint. The text is Section 3.2.2 of Dr. Bob's biomechanics notes. Use the further simplified planar 1-dof human arm model where L_1 is the upper arm length, L_2 is the forearm length, L_3 is the hand length, $\theta_1 = 0$ is the absolute shoulder pitch angle, θ_2 is the relative elbow pitch angle, and $\theta_3 = 0$ is the relative wrist pitch angle.

Your assignment is to replicate the plots given in the notes. Choose either the adult female or adult male model, whichever you chose in Matlab Assignment #1. For the pseudostatics simulation, animate the simulated human arm to the screen.

1. Perform biceps **pseudostatics** simulation in Matlab according to the same inputs as in the notes. Plot:
 - Cycloidal input angle θ_2 vs. time
 - Biceps pseudostatics results (t_B vs. time)
 - Biceps pseudostatics results (F_e vs. time)
 - Simulated muscle lengths (biceps and triceps) vs. time
 - Initial and final arm poses (y vs. x ; square axes with equal X, Y , ranges).

As the notes point out, this simulation is not acceptable since there is negative biceps tension at times; therefore:

2. Perform triceps **pseudostatics** simulation in Matlab according to the same inputs as in the notes. Plot:
 - Triceps pseudostatics results (t_T vs. time)
 - Triceps pseudostatics results (F_e vs. time)

The other plots will be identical to those from 1. above. For easy comparison, next plot the biceps and triceps pseudostatics results on the same graph (two graphs with t_B , and t_T , vs. time and F_e vs. time) and discuss your results.

The first page of your Matlab Assignment #2 report must be a one-page memo. You are expected to work with others on the concepts and Matlab strategies – however, all computer work and written work must be strictly individual. Start early and ask questions at any time – the answer key for this assignment is in the notes.

Matlab Assignment #3

due Thursday 5/29/8, by 9:10 a.m.

NO LATE ASSIGNMENTS WILL BE ACCEPTED!

Matlab Assignment #3 focuses on the dynamics simulation of the human elbow joint. The text is Section 3.3.2 of Dr. Bob's biomechanics notes. Use the same simplified planar 1-dof human arm model from pseudostatics where L_1 is the upper arm length, L_2 is the forearm length, L_3 is the hand length, $\theta_1 = 0$ is the absolute shoulder pitch angle, θ_2 is the relative elbow pitch angle, and $\theta_3 = 0$ is the relative wrist pitch angle.

Your assignment is to replicate the plots given in the notes. Choose either the adult female or adult male model, whichever you chose in Matlab Assignments #1&2. For the dynamics simulation, animate the simulated human arm to the screen.

1. Perform biceps **dynamics** simulation in Matlab according to the same inputs as in the notes (use only $t_F = 0.5$ sec). Plot:

- Cycloidal input angle θ_2 and derivatives through jerk vs. time
- CG accelerations vs. time
- Biceps dynamics results (t_B vs. time)
- Biceps dynamics results (F_e vs. time)
- Simulated muscle lengths (biceps and triceps) vs. time
- Initial and final arm poses (y vs. x ; square axes with equal X, Y , ranges).

As the notes point out, this simulation is not acceptable since there is negative biceps tension at times; therefore:

2. Perform triceps **dynamics** simulation in Matlab according to the same inputs as in the notes (use only $t_F = 0.5$ sec). Plot:

- Triceps dynamics results (t_T vs. time)
- Triceps dynamics results (F_e vs. time)

The other plots will be identical to those from 1. above. For easy comparison, next plot the biceps and triceps dynamics results on the same graph (two graphs with t_B , and t_T , vs. time and F_e vs. time) and discuss your results.

The first page of your Matlab Assignment #3 report must be a one-page memo. You are expected to work with others on the concepts and Matlab strategies – however, all computer work and written work must be strictly individual. Start early and ask questions at any time – the answer key for this assignment is in the notes.