

# MATLAB Assignment 4

Due Date: October 13, 2011

**Turning in your homework:** place all your files in a directory called “lastNameDate”; zip that directory and drop it in the mailbox at Learn@UW.

**Problem 1.** Implement a MATLAB parser to generate all the information required to fully characterize a translational joint in the context of 2D Kinematics and Dynamics analysis when the joint is specified like below. Note that there is a motion that can be prescribed on this joint. This is precisely the translational motion discussed in class and you can find in the textbook at page 94, Fig. 3.5.9. For simplicity make sure you define your  $\bar{\mathbf{v}}_i$  and  $\bar{\mathbf{v}}_j$  vectors such that  $\|\bar{\mathbf{v}}_i\| = \|\bar{\mathbf{v}}_j\| = 1$ . You might want to normalized them just in case, see example below, where  $\bar{\mathbf{v}}_i = [1 \ 1]^T$  is not a unit vector if defined as in the following adm file snippet:

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
TranslationalJoint: 3          % id of this constraint
BodyI: 4                      % id of body I
BodyJ: 3                      % id of body J
xPprimeI: 0.6                 % x of point P on body I
yPprimeI: -3.1               % y of point P on body I
xPprimeJ: 0.3                 % x of point P on body J
yPprimeJ: -4.1               % y of point P on body J
vPrimeIx: 1                  % x coordinate of the v_i vector expressed in LRF
vPrimeIy: 1                  % y coordinate of the v_i vector expressed in LRF
vPrimeJx: 0                  % x coordinate of the v_j vector expressed in LRF
vPrimeJy: 1                  % y coordinate of the v_j vector expressed in LRF
CmotionFunction: NONE        % provides expression for C(t)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Important Observation: Note that since the “NONE” keyword was used, it means that for this example there is no time function provided and as such there is no motion acting in conjunction with this joint.

**Problem 2.** Last week’s assignment and the problem above collectively introduced what effectively is a model definition language. Using this language generate an adm file (a text file), called myFristModel.adm, that is associated with (defines, models) the mechanism in Example 3.1.1, page 51. In

that example, consider  $f(t) = \sin(2t)$ . Your adm file should be a succession of modeling elements that have been introduced in this and the previous assignment that together completely define the mechanism considered. Please use the absolute constraints we discussed in class to take care of this model.

Note: You only have to generate the adm file for this assignment, there is nothing to be done in MATLAB here. In the next assignment you'll have to parse the adm file and do something useful with the information you extract out of this file.

**Problem 3.** Consider the Example 3.1.2 at page 54 of the textbook. For that mechanism, use  $l = 2$  and impose a motion on the revolute joint between body 1 and ground that results in a constant angular velocity  $\omega_1 = 6$  rad/sec. Note that at  $t = 0$ ,  $\phi_1 = 0$ . Generate a pair of input files `twoBody.acf` and `twoBody.adm` that will be used in a future assignment by your `simEngine2D` to perform 10 seconds worth of Kynematics analysis of the mechanism using a step size of  $\Delta t = 0.001$  seconds. Specify in the acf file that the output should be saved at 500 intermediate points.

Note: You might want to take a look at MATLAB Assignment 2 to see how the acf file was defined.

**Problem 4.** Consider the four bar mechanism of slide 9 of the October 6 lecture and use Approach 1 to generate a pair of input files `fourbar1.acf` and `fourbar1.adm` that will be used in a future assignment by your `simEngine2D` to perform 5 seconds worth of Kynematics analysis of the mechanism using a step size of  $\Delta t = 0.01$  seconds. Specify in the acf file that the output should be saved at 100 intermediate points. Note that a joint motion is specified between bodies 1 and 4 to control the angle between the global reference frame and the local reference frame associated with body 1. The expression for this motion reads  $\phi_1 - \pi/2 - 4t = 0$ .

**Problem 5.** Consider the four bar mechanism of slide 9 of the October 6 lecture and use Approach 2 to generate a pair of input files `fourbar2.acf` and `fourbar2.adm` that will be used in a future assignment by your `simEngine2D` to perform 5 seconds worth of Kynematics analysis of the mechanism using a step size of  $\Delta t = 0.01$  seconds. Specify in the acf file that the output should be saved at 100 intermediate points. Note that a joint motion is specified between bodies 1 and 4 to control the angle between the global reference frame and the local reference frame associated with body 1. The expression for this motion reads  $\phi_1 - \pi/2 - 4t = 0$ .