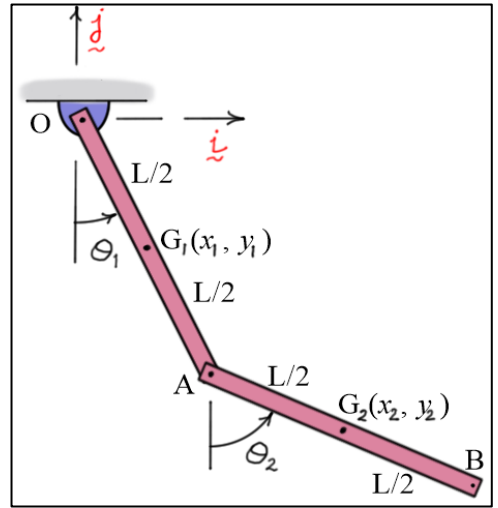


# Multibody Dynamics

## Exercises #8 Simulink/SimMechanics Models

In Exercises #6, the equations of motion of a double pendulum were formulated using Lagrange's equations. In part (a) *two* equations were formulated for the *independent* set of generalized coordinates  $\theta_1$  and  $\theta_2$ , and in part (b) *ten* equations of motion were formulated for the *dependent* set of *six* generalized coordinates  $(x_1, y_1, \theta_1)$ ,  $(x_2, y_2, \theta_2)$ , and *four* Lagrange multipliers.



- a) Build *three* different models of the double pendulum using SimMechanics and Simulink. Use SimMechanics to build a dynamic model of the system and use Simulink to build *two dynamic models* of the system using the *two different sets* of differential equations of motion.
- b) Simulate the motion of the pendulum using the data below to show that the three models give the same results.

Physical Data:

$mg = 5 \text{ (lb)}$
$g = 32.2 \text{ (ft/s}^2\text{)}$
$L = 2 \text{ (ft)}$

Initial Conditions: (starts from rest)

$(\theta_1)_{\text{initial}} = 25 \text{ (degrees)}$
$(\theta_2)_{\text{initial}} = 35 \text{ (degrees)}$
$(\dot{\theta}_1)_{\text{initial}} = (\dot{\theta}_2)_{\text{initial}} = 0$

- c) Execute the models using M-files (or a single M-file) and “publish” the results to PDF files (or a single PDF file). *All plots* should be *labeled* indicating which variable is plotted on that graph. Include a comparison of the results of your models in the published file as well.

**Note on using Simulink:** For more complex models (such as that for part (b) above), it is helpful to organize the block diagram using *subsystems*. Subsystems allow portions of the block diagram to be condensed into a single block with clearly defined input and output signals. Subsystems themselves can be complex, and they can even contain other subsystems. When used effectively, subsystems can make it easy for the analyst to understand the operation of complex systems.