

# Biorola Simulation Library/Template

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- Author: Austin Wang
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- Requirements: MATLAB version R2013a or newer, Symbolic Math Toolbox \* (Note: R2014a or newer is preferred due to GUI issues)

## Introduction

- A template for deriving the state equations of a system and simulating it through time.
- In template files, areas enclosed in `%*** ... ***` should be filled in by the user.
- Two examples are included in this package. (double pendulum and bouncing ball)
- Functionalities in the toolbox can also be explicitly used without following the templates.

## File List

**Toolbox files (packaged functions that perform complex tasks):**

**toolbox\downhillMinSearch.m**

- A downhill search algorithm that finds the local minimum of a function.
- (Specific information is included in the comments in the file)

### **toolbox\lagrangian2eqns.m**

- Formulates the system state equations from the Lagrangian.
- (Specific information is included in the comments in the file)

### **toolbox\plot\_gui.m**

- A interactive GUI for visualizing simulation results.
- (Generated video files will be placed in \videos)

### **toolbox\plot\_gui\_old.m**

- A interactive GUI for visualizing simulation results.
- For R2014a and older.
- (GUI is flawed, can only output to video file)
- (Generated video files will be placed in \videos)

## **Template files (incomplete codes that users can modify):**

### **equation\_generation.m**

- Generates system equations and event functions.
- (Generated files will be placed in \functions)

### **ode\_simulation.m**

- Utilizes ode45 to simulate an ode system.
- (Generated files will be placed in \results)

### **functions\drawFcn.m**

- Plot a drawing of the system configuration from generalized coordinates.

### **functions\ode\_simulation\_func.m**

- Function form of ode\_simulation.m (for mass searching).
- Returns simulation results as output instead of saving to file.

## **Other Files**

### **result\_visualizer.m**

- Calls respective GUI functions to visualize simulation results.

### **functions\eventFcn\_default.m**

- An empty event function as a default for systems without events.

## **Instruction Manual**

1. For each new system, make a copy of the entire **\template** folder
2. Define system equations in **equation\_generation.m**
3. Setup simulation settings and initial conditions in

## **ode\_simulation.m**

4. Define a plot of system in functions **\drawFcn.m**
5. Run **equationGeneration.m** to generate equation files
6. Run **ode\_simulation.m** to obtain simulation results
7. Run **result\_visualizer.m** to view/save simulation results