Dynamics Lab User Manual

Dynamics Lab is a initial value problem and differential equation solver and visualizer that allows the user to easily navigate a 3-D space in first-person witness of his or her input fields.  
  
Dynamics Lab allows for the easy visualization of three problem categories. Each can be accessed by the **Menu** button in the top left corner at *any* given time.

1. Spring Mass Systems - View a single Spring Mass imitation in a perfect, one-instance space.
2. 3D Motion - Observe any number of mass-less objects move according to 1st or 2nd order differential equations.
3. N-Body - View any number of mass objects follow a trajectory course through the world space.

Spring Mass -------------

The **Spring Mass Systems** component can be accessed by mouse-clicking the Menu option in the top left corner and Spring-Mass. Within the level space, the user may insert new values into the **Friction, Mass, Stiffness** input fields located in the top right corner before pressing the Space bar to begin running the simulation (unless the default values are desired). The simulation can be paused and parameters changed real-time. Problems deemed impossible in a closed-system should be theoretically observable through specific inputs (such as negative friction). The simulation should be able to be reset at the click off a GUI button.

* By holding 'alt' and moving the mouse, the user view of the scene will rotate.

3D Motion -------------

To enter **3D Motion**, click Menu in the top left corner and select 3D Motion. A blank scene with uncluttered GUI options on the upper and lower sections of the screen should appear.

To add any number of spherical objects, click the '>' carrot in the bottom right corner. Similarly, '<' removes the currently selected (yellow highlighted) simulation object.

* Each object's 3-D coordinate position is given above the object in [x,y,z] format. Removing the object will remove the space coordinates above it.
* The initial positions of each object can be manipulated through the 'Set State...' button, the 3rd from the left on the upper GUI bar. The values shown The values should update as objects are cycled through.

To change **input equations**, click '3D Motion Setup...,' the second button from the upper left ccorner of the GUI. The 3D Motion Configuration menu that pops up in the middle of the screen presents three definable vector fields [ x'(t), y'(t), and z'(t) ]; or, when working in 2nd order should [x''(t), y''(t), and z''(t) ]. Usable variables appear near the right side of the window.

* New parameters may be listed below the three input fields beneath the 'List Parameters' description. These values must be listed in this fields in order to auto-populate the 'User Defined' variables menu, found to the left of the red 'Reset' button on the top of the GUI.

1. For example, if the variable 'k' is created, it must be set by typing 'k = 3' under User Defined Parameters.

* If the equations you have input are free from errors and are readable by the program, a green 'Ok' should show above the 'Cancel' button. If it does not say 'Ok' or the text is red, check your equations for any problems.
* Quickly save and load input equations by clicking the respectively named 'Quick Load' and 'Quick Save' options on the right side of the configuration menu.
* If 'Cancel' is pressed, the configuration menu will close and all equations and fields be reverted to their state prior to editing.

**To begin simulation**, press 'Start' in the top right corner. When the simulation is running, 'Stop' will be written in its place. Pressing the Space bar will perform both the Start and Stop functions as well.

* Pressing 'Reset' will revert each object to their initial state.
* Additionally, initial 'time' can be set in the input field denoted by 't='. Time can be changed real-time by dragging the red bar on the lower GUI bar.
* While the simulation is running, pressing **'s'lower** or **'f'aster** will decrease or increase speed.
* Whether the simulation is running or not, pressing **'v'ector** will activate (or deactivate) the Vector Field representation of the input equations. **'b'** and **'c'** will, respectively, increase or decrease the space distance of the Vector Field. The Vector Field be visualized irelevant of the number of objects in the level space.
* By holding 'alt' and moving the mouse, the user perspective of the scene will rotate.

The user may **save his or her own equations** and testing modules in .3dmotion format by pressing '**Saved Problems**' button in the top-center of the GUI.

* Saving your own file will save equations listed in the 3D Motion Configuration menu (as well as the order), automatically incorporating initial state positions of all objects currently created.
* The '**Save Data**' button, located to the left of 'Saved Problems,' will dump the raw data of all objects (their position, etc.) into a format text file within the program folder beside the Dynamics Lab executable.