

LabSim Instructions

The LabSim program is a computer simulation of the actual physics lab experiments you do in class. Simulation is a very powerful technique which lets you do things you can't do and see what happens in circumstances you couldn't possibly have in the real world. That may sound silly (why would anyone *care* about what happens in a totally unreal world, you may ask), but is actually very useful. If your data doesn't match your predictions, a simulation can help you find out what is causing the difference by letting you look at the consequences of different potential causes by themselves, and seeing what effects they make in isolation, without getting confused with something else.

For example, suppose you thought your real experiment didn't match your predictions because of air resistance (which is present in the real world, but is not included in your predictions). A simulation lets you investigate the effects of air resistance by itself, without getting confused with other kinds of friction. Simulations also let you “turn up” air resistance to ridiculous levels, so you can really see clearly just what it does. If air resistance does act like the problems you see in your data, then it might be the cause, but if it doesn't behave like the problems in your data, then you should look elsewhere.

The LabSims are meant to let you “explore the experiment”, and to see, in a very hands on way, just what different physical effects can do. Feel free to play around with your LabSim, and to make it do all the weird things you want. You can't break it, and you might learn something!

Using the LabSims

The easiest way to get started with the LabSims is just to push the Run button, which is right under the 3D window (it's the black button with the “>” label). “Run” just makes the labSim go, using whatever values are in the yellow windows to the left. You can change how long it runs by changing the number of frames (the current frame number is shown to the right of the run button). The “|<” button is a restart, which puts the 3D view back to its starting position. The “||” button is a “pause”, which stops everything. The buttons are meant to look like those on a DVD player or VCR.

3D navigation

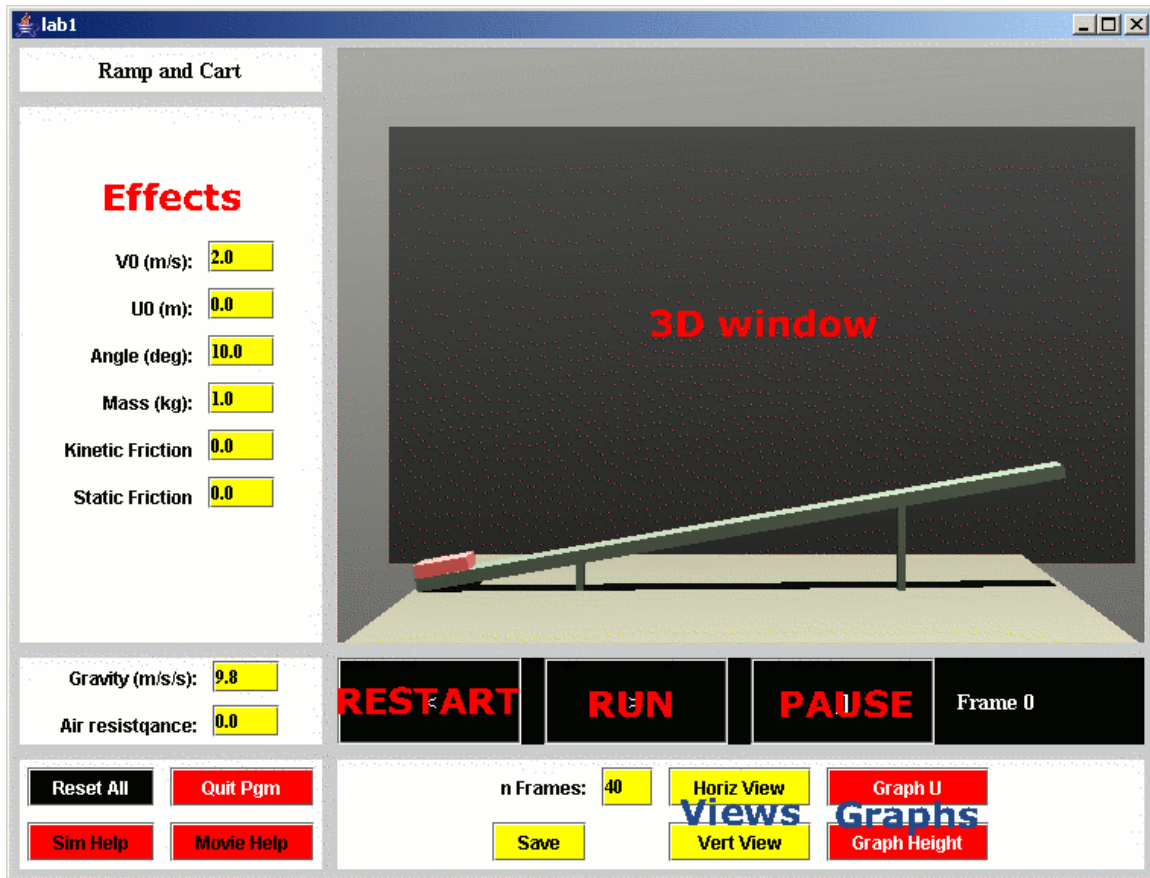
You can walk around in the 3d window by using the arrow keys (but first you **MUST** put the mouse in the 3d window). The arrows move you around rather like in a video game, which some of you may have experience with. Holding down ALT while you push the arrows lets you move up and down or back and forth (gamers call it a “strafe” button) and CTRL lets you tip up and down.

When you get lost

If you get lost in the 3D space, click the “Horiz View”, “Vert View” or “Reset All” buttons. Horiz View brings you back to your starting point, Vert View puts you over the table looking down, and Reset All resets everything to where it was when the program started.

Parameters

The panel to the left of the 3D view has names and values of all the things you can vary in the experiment. You change them by typing in new values, then see what happens by pushing Restart and Run again. If you enter something totally impossible like a negative mass the box will turn red and the program will demand that you change it. If you change so many things you don't know where you are anymore, and you just want to get back to some reasonable defaults, click on “Reset All” in the lower left panel.



Graphs

The best way to use the labsims is with the realtime graphs. If you push one of the red graph buttons at the bottom right, a separate window will pop up. The new window will be rather empty until you do a run in the 3D window, after which it will have graphs of position and speed. The top graph is the position, and the bottom one is speed (which position and speed depends on the button). You can change the limits on the graphs, redo the plot and so on with the boxes on the left side of the graph window.

Graphs are really useful for comparing different runs and seeing what happened. If you do one run, then change something and do it again, you can see what I mean (click on the new color button after the first run). The graph windows are a great way to see what an effect does.

One thing you should definitely look into is measurement error, which you can do with

the “Add error” button in the graph window. This button lets you simulate measurement error by adding randomly distributed errors to the position measurements (the idea is to simulate what happens if you can't get a totally accurate position click in VideoTool). You can set the size of the error with the number in the box, and add it several times if you want. The velocity values are recalculated when you add error to the positions, so you can see what happens to velocity if your position measurements are off.

Making Movies

The highest tech, but slowest, way to use the LabSims is to make a movie with them. Movies are nice because you can analyze them with the same software you use to analyze your real data.

To make a movie, first you should clean out any old frames by clicking the “Cleanup” button on the computer desktop. Then you should play around with the LabSim until you have a run and a camera position you like. Click on the yellow “Save” button, which writes a little file to disk with the positions of the apparatus in every frame. Now click on the “Make Frames for Lab x” button on the desktop, which will start up a program called PoVRay. PoVRay makes high quality movie frames of the experiment (it will take a couple minutes). Finally you can turn the frames into a movie (which will be in c:\labSim\frames\simMovie.avi) by clicking on the “Make movie from frames” button. Then you can read the movie into VideoTool and analyze it with that.