WPI | Department of Physics

Double Pendulum

114X

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Lab Objectives

- Build and design your own double pendulum from items that are readily available
- Record video of your setup and transfer it into a programming language
- Plot your data and look for patterns

Lab Equipment

- String (try to find some string that is at least 1 meter)
- Two masses of different weights
- Camera or phone camera
- Tracker Software or other similar video tracking software

Warm up questions

Please consider watching this video for an overview of a double pendulum. Professor Lee talks about the equations needed for a double pendulum in the first few minutes of this video, and a double pendulum is demonstrated around 7:30.

The assumption is that you will not have the ability to make a rigid double pendulum, but you can use string to make a double pendulum. In order to make a double pendulum with string your top mass needs to have a higher momentum than your lower mass. Why might that be?

Procedure

Build your real-life double pendulum, measuring the lengths and getting a rough estimate of the masses. If the momentum of the top half needs to be higher than the bottom half this means the upper weight should be about twice as heavy as the lower weight. Experiment by moving some of the mass until they oscillate in an interesting way.

Record the motion of your pendulum several times from different initial angles. Try also to record the motion of your pendulum multiple times from a similar large initial angle.

Import the video into Tracker and track the position (x and y) and velocity (x and y) of both masses. Export your data from Tracker into a CSV and load that CSV into the programming tool of your choice to construct your plots.

Plotting your data

Please plot for each mass

- x vs y
- Your general phase spaces plots (eg: x vs x velocity)
- At least one random plot that you think no one else has done!

Experiment with different fitting functions that seem reasonable and then do a chi-squared test to determine if your fitting function is a good fit.

Acknowledgment

Thank you to Charles Platt for their article here that was extremely helpful in the creation of this lab.