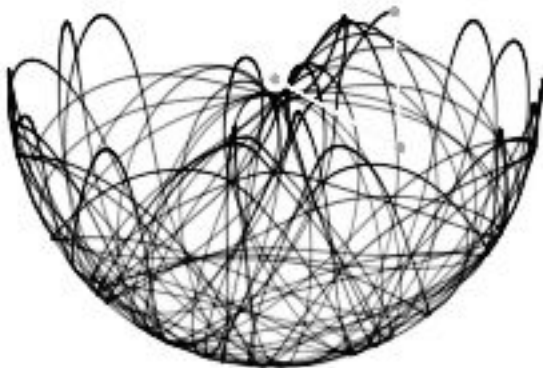


Double Pendulum Designer

June 19th, 2018

Project Overview

The Double Pendulum Designer is a user interface application that allows the user to input a set of values and observe the movement of a double pendulum.



What is a Double Pendulum?

The double pendulum consists of one pendulum attached to another. It demonstrates a simple system that exhibits a complex behavior. The chaotic movement of the double pendulum makes it unpredictable.

What do u mean by “chaotic”?

To provide an example, if two pendula with only a difference of initial speed of 0.1, is swung at the same condition their behaviour quickly diverges. This is called chaotic as each pendulum are sensitive to their own conditions.

How Does the Double Pendulum Work?

The motion of the pendulums is governed by a pair of coupled differential equations.

$$\theta_1'' = \frac{-g(2m_1 + m_2) \sin \theta_1 - m_2 g \sin(\theta_1 - 2\theta_2) - 2 \sin(\theta_1 - \theta_2) m_2 (\theta_2'^2 L_2 + \theta_1'^2 L_1 \cos(\theta_1 - \theta_2))}{L_1 (2m_1 + m_2 - m_2 \cos(2\theta_1 - 2\theta_2))}$$

$$\theta_2'' = \frac{2 \sin(\theta_1 - \theta_2) (\theta_1'^2 L_1 (m_1 + m_2) + g(m_1 + m_2) \cos \theta_1 + \theta_2'^2 L_2 m_2 \cos(\theta_1 - \theta_2))}{L_2 (2m_1 + m_2 - m_2 \cos(2\theta_1 - 2\theta_2))}$$

Input & Output

The user will input values for mass and length. After clicking the [CREATE] button, the screen will display a double pendulum created by a set of uniquely inputted values.

Classes

Main Class - (DoublePendulum.java)

Fields	
Int xStart, Int yStart	The x and y value of where the pendulum will be positioned
Int l1, Int l2	The two lengths of the double pendulum
Int m1, Int m2	The two masses of the double pendulum
Double angle1, Double angle2	The starting angles of the pendulum
Double angle1Vel, Double angle2Vel	The velocities of the two angles that will change the movement of the pendulum
Weight Weight1, Weight Weight2	Accelerations of the two masses
ArrayList array	Array list that keeps track of the second mass

	to draw the path
ArrayList weight1Acc, ArrayList, weight2Acc	Arraylist that stores the angles and uses it to animate the double pendulum
Int time	Index needed to animate the pendulum
Int g	Gravity

Class - (Weight.java)

Fields	
length	Length connecting the pendulum
velocity	Velocity of the weight
angle	Angle of the weight
acceleration	Acceleration of the weight
x2,y2	x and y values of the pendulum

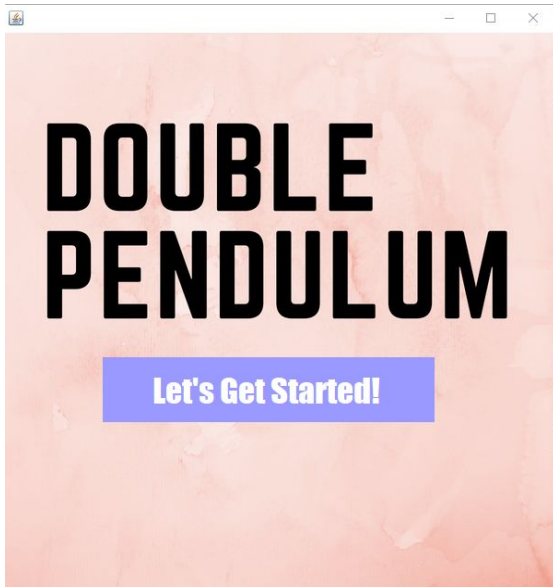
JFrame - OpeningScreen.java

Opening screen for the program

JFrame - Selection.java

JFrame where the user will choose values(two masses, and lengths) for the double pendulum and when the CREATE button is clicked, the main class (DoublePendulum.java) is run.

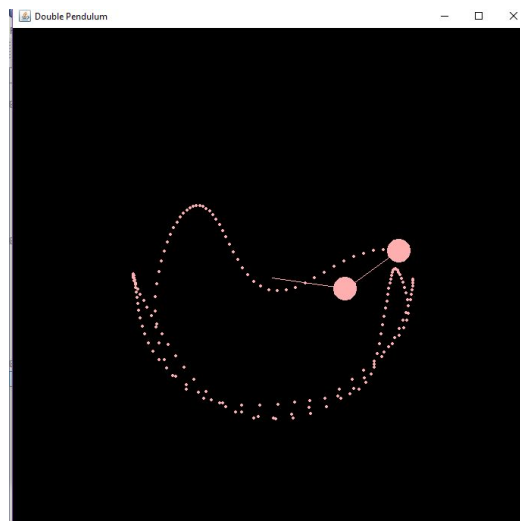
DEMO



First screen of the program

The image shows the user input screen. It has the same light orange background. At the top, there are two orange headers: "MASS 1" and "MASS 2". Below "MASS 1" is a white input field with the number "30" and a small up/down arrow. Below "MASS 2" is a similar white input field with the number "30". Further down, there are two more orange headers: "LENGTH 1" and "LENGTH 2". Below "LENGTH 1" is a white input field with the number "40" and a small up/down arrow. Below "LENGTH 2" is a similar white input field with the number "50" and a small up/down arrow. At the bottom center, there is a red rectangular button with the text "Create!" in white.

User input the values from the double pendulum



Animates the pendulum