A Report on "Fuzzy controller for inverted pendulum"

Group14 - 1501CS14, 1501CS16,1501CS37

OBJECTIVE - The pendulum is in dynamic equilibrium, i.e., it continuously slips from the vertical, and is brought back continuously through the application of torque resulting from the applied current.

APPROACH - To keep the pendulum in vertical position, a torque is applied proportional to current whenever the pendulum departs from vertical. The appropriate current for a given **displacement(θ)** and **angular velocity(ω)** is calculated using **Fuzzification** and **Defuzzification**.

Fuzzification:

STEP1: Create profiles of **θ** and **ω**.
STEP2: Find belongingness **$\mu(i)$** of **i** from the above profiles.

Defuzzification:

STEP1: Create profile of current **i**.
STEP2: Find the value of **i** using it's profile and belongingness value.
Assumption : Angular Acceleration = k*i where k = 1.

CODEBASE :
We have created a gradle project for the simulation of Fuzzy Controller for inverted Pendulum.

File 1 : FuzzyController.java
        This is the file which deals with all the fuzzy logic i.e fuzzification and defuzzification related to controller for inverted pendulum.
Libraries Required : fuzzylite

Method description :

getEngine() : This method initialize the Engine of Fuzzy Controller i.e with input variable **θ** and **ω** and output variable **i** .Also initialize the set of control logic.
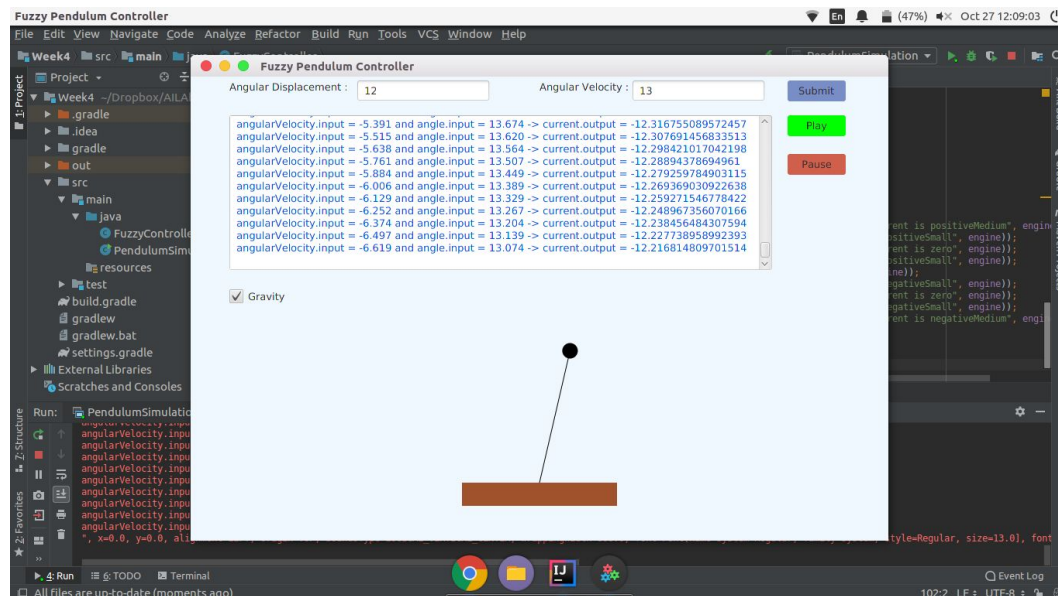
process(angularDisplacement,angularVelocity) : This method takes **θ** and **ω** and returns **i.**

File 2 : PendulumSimulation.java :

This file deals with the GUI part which is done using javafx.

GUI:

GUI consists of Labels, Text fields, Buttons, Checkbox for Gravity, Pendulum(Created by line,circle and rectangle)

User Enters Angular Displacement and Angular Velocity and on-click to submit button these value is sent to process method of FuzzyController.java

Which returns the current and displaced in text area.

There is also play and pause button to stop and resume the simulation.Refresh rate is taken to be 0.01s.