Fuzzy Controller Project

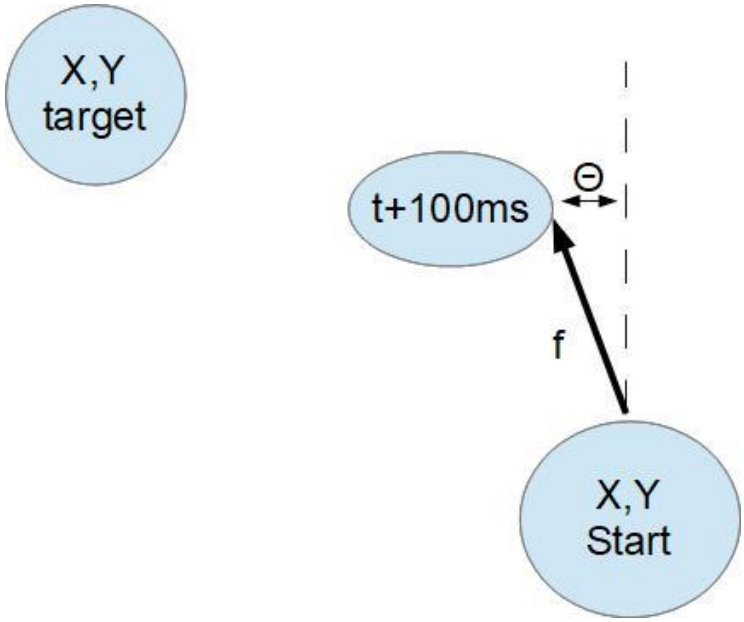
Assigned: September 10, 2021
Check In: September 17, 2021
Due: October 1, 2021

You will be designing an autonomous control system for a robot using Fuzzy Logic. The system aims to take a robot from one location to a designated second spot.

Ever 100 ms the robot will move based on your fuzzy logic controller. The controller will know the current location of the robot and the angle and distance to the destination. The system is able to move the robot by changing the angle it is facing (rotational acceleration) and the speed the robot is moving (forward acceleration, noted by the angle it is facint). This is similar to the inverted pendulum problem. The starting angle will be 0 degrees and velocity is zero. Use $d=\text{sqrt}(a^2+b^2)$ for the distance calculation that you need for this problem.

To help you get started, you can look at the idea at a point of time the robot is in a given state, R. From that state the next state can be calculated. This calculation is done with the assumption that the chance in $\boldsymbol{\Theta}$ and speed happen instantaneously that the 100ms move will use those values. Then after 100ms the angle and speed are updated again, and repeats until the destination is reached.

To help you visualize the system, you can look at this figure.



You are allowed to use whatever approach you would like but it must be done in MatLab and include the appropriate CI requirements. If you use any libraries it must also be documented. Additional problem specifications are included in the deliverable details. Anything not specified is up to you to define in a way that makes sense for the problem.

Check In (20 Points):
A simple document confirming the first elements of the engineering design process have been accomplished.

- Summary of what is the problem
- What are the inputs
- What are the outputs
- What are the constraints
- What things did you have to define because it wasn't specified
- Identify an ethical concern that must be taken into account in development to avoid issues when it is let loose.

Submit as a PDF

Questions/elements to be addressed in the report (100 Points):

1. What are the system inputs
2. What are the system output
3. What are the constraints
4. Anything you defined
5. Explain the physics equations for the robot's movement
6. How the fuzzifier was designed, you should have your two inputs mapped to fuzzy inputs that consist of 5 sets. Make sure to create the plots for your fuzzifier
7. How you designed your fuzzy inference engine
    a. Explain the rules you came up with
8. How the defuzzifier was created and functions, also creating the plots
9. Present the results of your system. Do for three different input criterias.The first test case criteria is using the starting point of x=0, y=0 and a time stamp of 100 ms per move with user inputted x,y coordinates
    a. At each time stamp, output the following:
        i. weights of each membership function at that given time
        ii. new angular velocity
        iii. new forward force
10. Follow up on the ethical issue. Summarize it, explain how it was addressed. Either explain remaining elements of that ethical concern for future

iterations/versions of the prototype system that was designed or identify a new ethical concern to be addressed.

The report should be appropriate technical writing about the project, not about you. Overall writing quality of the report will factor in for 10 points.

Submit as a PDF.

Read Me Document (20 Points):

- Create a read me document that gives instructions to a user of how to execute your program.

This is not about you. Make sure your wording is appropriate. Submit as a PDF.

Reflection Blog Post (10 Points):

- Describe your experience
- Challenges
- Easy things
- At least 1 spot identified for potential improvement

Submit as a PDF.

Code submission (60 Points):

1. User input of the starting location
2. User input of the destination
3. At each time stamp, output the following: weights of each membership function at that given time, new angular velocity, and new forward force, include a sample case in the report
4. Proper commenting
5. Proper header
6. Able to reach the destination

If it doesn't work when the Read Me is followed, it will cancel out any report elements that present results. Submit as your single MatLab file. If you have more than one file, zip them together and submit the zipped file.

I gave up, I don't know, I ran out of time...All unacceptable to be in the report and read me. If it occurs in any of your documents that is where grading ends.