

Deliverable exercise FC: Compound Pendulum

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Master in Artificial Intelligence



Planning and Approximate Reasoning
Work 4

10th January 2024

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1 Introduction

2 Design of the Fuzzy Controller

2.1 Membership functions

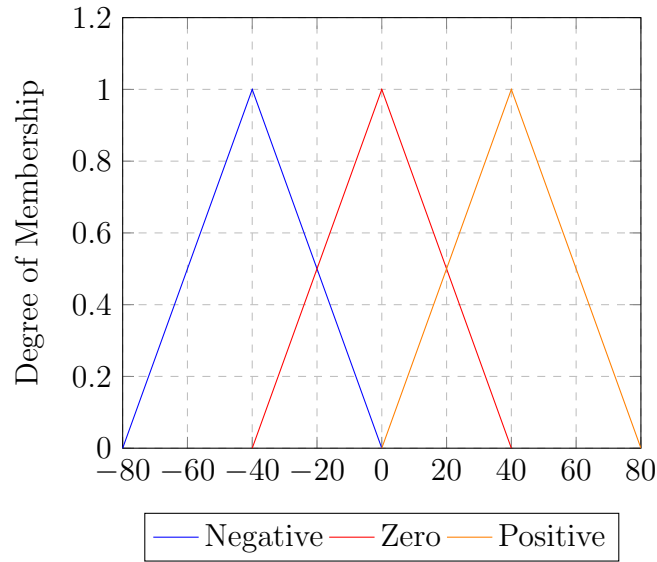


Figure 1: Membership Functions for Input Variable "Error"

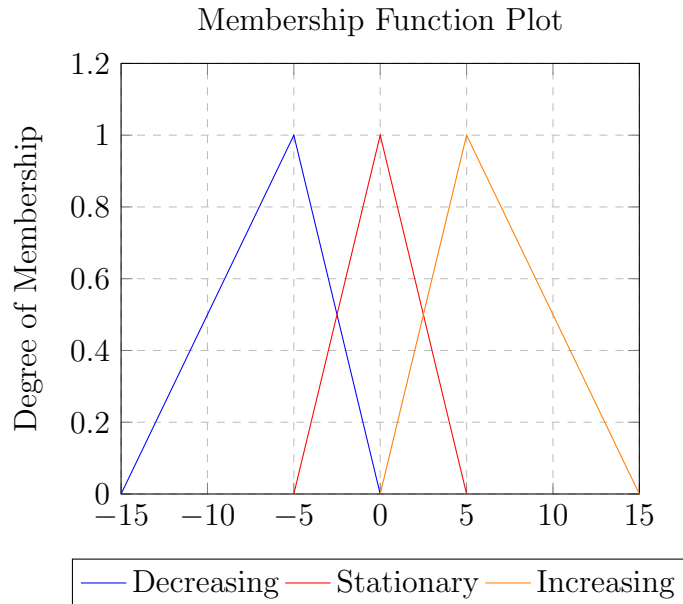


Figure 2: Membership Functions for Input Variable "Error Derivative"

Note: The range for the error derivative was modified from the initially proposed values of $[-5, 5]$ to $[-15, 15]$. This adjustment was necessary because the original range was insufficient, causing the derivative to exceed its bounds. Consequently, the fuzzy controller outputted a value of zero during the Simulink simulation. The revised range provided more accurate and reasonable results.

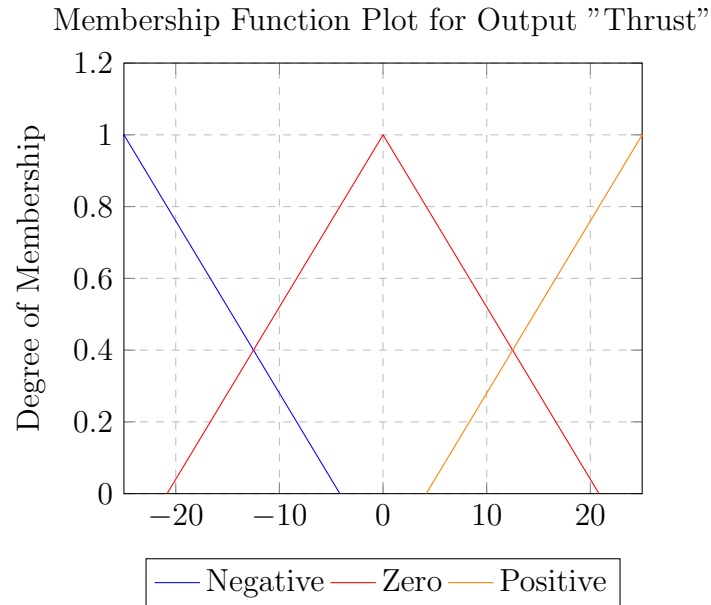


Figure 3: Membership Functions for Output Variable "Thrust"

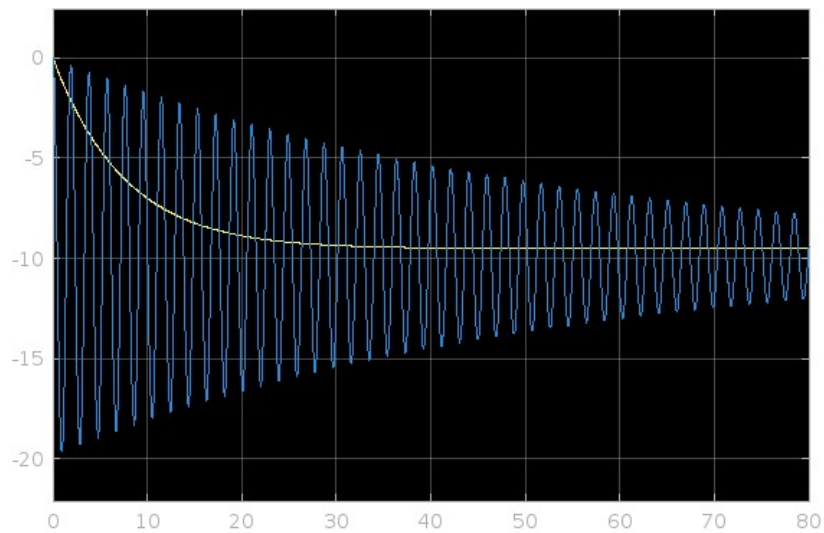
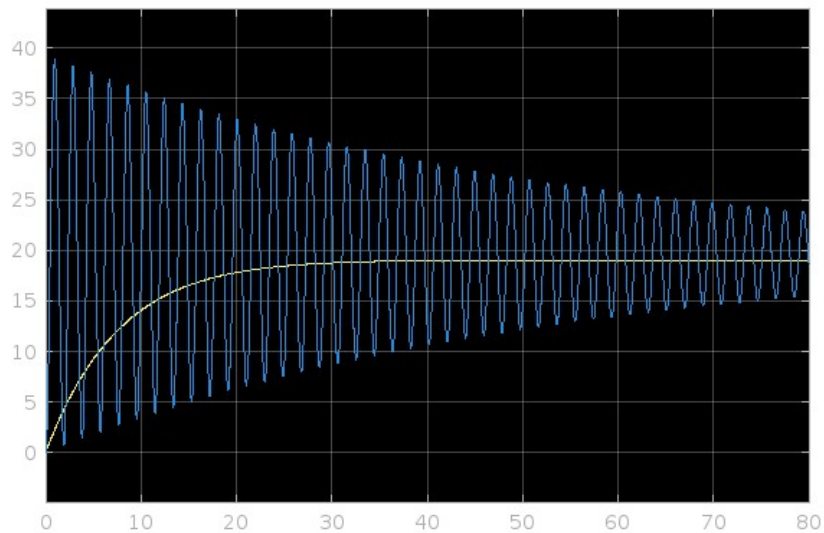
Maybe comment about that defining the lowest (and highest) membership function as a triangle (which decreases after reaching its maximum, if we further decrease it: see screenshot) is not a good idea in our opinion as it is not realistic, but we did it this way to follow the instructions since, it was defined as a triangle in the exercise.

2.2 Rules

Error	Error Derivative	Thrust	Weight
Negative	Decreasing	Negative	1
Zero	Decreasing	Negative	1
Positive	Decreasing	Positive	1
Negative	Stationary	Negative	1
Zero	Stationary	Zero	1
Positive	Stationary	Positive	1
Negative	Increasing	Negative	1
Zero	Increasing	Positive	1
Positive	Increasing	Positive	1

Table 1: Rules and Corresponding Weights

3 Results



4 More complex controller

(with at least 7 membership functions)

TODO: "Explain and reason what happens if you increase the number of membership functions (7 or more) of the output?"

It doesn't talk about it, but if we design the 7 membership functions and the rules, we can implement it in another controller, and run the simulation to see what happens. I've created `pendulum-fuzzy-complex.fis`, but so far it is the copy of the original, nothing is modified.

5 Conclusions

References