

# Review Paper on Fuzzy Based Wall Following Robot Simulation in MATLAB

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**Abstract**— Fuzzy Logic is a Multi-valued logic that deals mathematically with imprecise and uncertain information provided by humans. The word ‘fuzzy’ means ‘unclear’. The term ‘fuzzy logic’ was introduced by Lofti A. Zadeh in 1965. Fuzzy logic has been used by many people involved in various fields such as research and development, software developers, business analysts, engineers and many more. This paper presents a review of some significant work in area of robotics in which simulation results of wall following robot is presented. Simulation is done by implementing fuzzy rules in MATLAB.

**Key words:** fuzzy logic, wall following, IR sensor, *Obstacle Avoidance*

## I. INTRODUCTION

Fuzzy logic is a superset of Boolean logic and has been extended to handle the concept of partial truth - truth values between “completely true” and “completely false”. Fuzzy systems are simple can be described using linguistic variables. Fuzzy logic is highly recommendable for highly non linear complex systems that do not have exact mathematical model or equations [1]. One of the applications of fuzzy logic is to design the controller for robot navigation [2] in various environments. Successful movement from one place to another in navigation system of robot require some features like obstacle avoidance[3]-[5], wall following[3],[6],[7],target detection[8],[9], path planning and tracking[4],[6],[10], etc. Mobile to provide the above features robots make use of various sensors, e.g. ultrasonic and infrared sensors [10], visual sensor [3], [11], also GPS device [11].

In this review paper Section I present the introduction. Section II represents Design concepts. Section III presents the Fuzzy based controller. Section IV presents the different results and Section VI concludes the paper.

## II. DESIGN CONCEPTS

Robot consists of the infrared sensors navigates in the field and senses the wall. In this robotic system there are two infrared sensors shown in Figure 1. IR1 and IR2 sense the wall or the obstacles. These values are formulated and supplied into fuzzy logic controller that gives the left wheel velocity and right wheel velocity as outputs.

## III. FUZZY CONTROLLER DESIGN

Sugeno type fuzzy logic controller for system is designed in MATLAB by developing the GUI. Fuzzy logic controller takes two input variables rangeL and rangeR as antecedent.



Fig.1: two IR sensor arrangements

Both the antecedents are partitioned to five fuzzy set each one with triangular functions shown in Figure 2 and Figure 3. The linguistic variables for both input variables are: v\_near, near, med, far and v\_far .Consequent variable also consist same linguistic variables but outputs L\_vel and R\_vel is partitioned into three singletons. Figure 4 represent the surface view for the system.

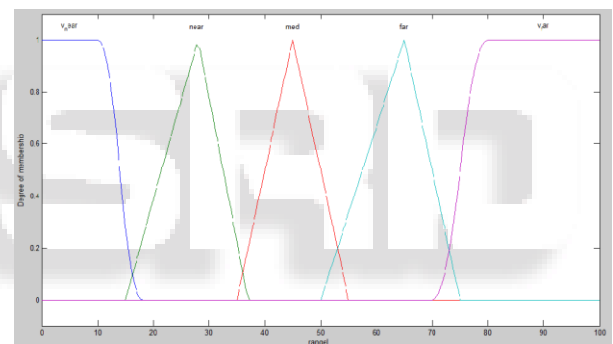


Fig. 2: Fuzzy sets of the variable rangeL (pixel)

Some of the applied Fuzzy rules that describe the behavior of robot are.

- (rangeL==v\_near) & (rangeR==v\_near) => (L\_vel=slow)(R\_vel=slow)
- (rangeL==v\_near) & (rangeR==near) => (L\_vel=slow)(R\_vel=slow)
- (rangeL==v\_near) & (rangeR==med) => (L\_vel=slow)(R\_vel=slow)
- (rangeL==v\_near) & (rangeR==far) => (L\_vel=med)(R\_vel=slow)
- (rangeL==near) & (rangeR==v\_near) => (L\_vel=slow)(R\_vel=slow)
- (rangeL==near) & (rangeR==near) => (L\_vel=slow)(R\_vel=slow)
- (rangeL==near) & (rangeR==med) => (L\_vel=med)(R\_vel=slow)
- (rangeL==near) & (rangeR==far) => (L\_vel=med)(R\_vel=slow)
- (rangeL==med) & (rangeR==v\_near) => (L\_vel=slow)(R\_vel=med)

(rangeL==med) & (rangeR==near) =>  
(L\_vel=slow)(R\_vel=med)

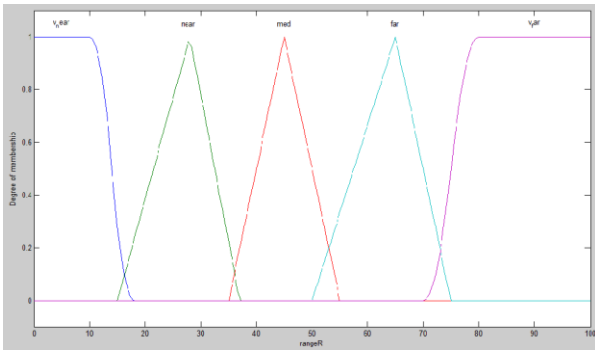


Fig. 3: Fuzzy sets of the variable rangeR (pixels)

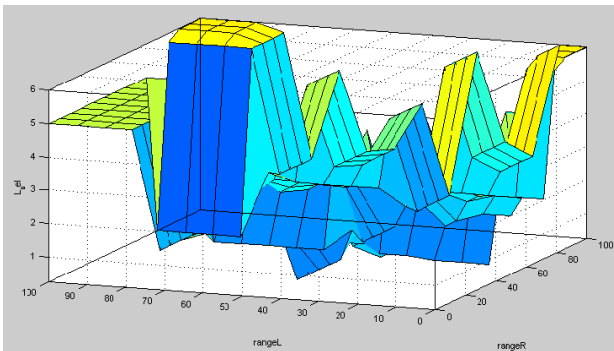


Fig. 4: surface view

#### IV. DISCUSSION AND CONCLUSIONS

This paper represents the designing of a two input, two outputs sugeno fuzzy logic controller for wall following. The measured distances fed into fuzzy controller as inputs with the help of two sensors, generate speed commands for left and right wheels. The controller is designed using MATLAB. Experimental results have validated the controller for wall following behavior and obstacle avoidance of mobile robot. The future work will concern about goal oriented behaviors to enable the robot in reaching the desired goal

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