

91.451, Robotics II  
Spring 2004  
Prof. Yanco

### **Lab 3: Behavior-Based Control Using Fuzzy Rules**

Out: Thursday, 26 February 2004

Due: Thursday, 4 March 2004

**Overview:** There are two methods of using behaviors: sequences and blends. Next week's lab will use sequencing for finite state machine based control and subsumption based control. To use blending, you need only have multiple behaviors active simultaneously. These are usually in the same state, but could be in different states. In this lab, you will use fuzzy rules to combine behaviors. First, you'll be introduced to fuzzy logic in Pyro, then you'll look at BBWander.py to see how fuzzy rules are used. Then you will write behavior based wall following code (you can either modify your code from Lab 2 or you can start from scratch).

#### **Part I: Investigating Fuzzy Rules and BBWander.py**

To start, read "Horizontal Behaviors" section of the behavior based module (attached). Fuzzy rules will allow us to combine behaviors based upon a statement's degree of truth. For example, if you are checking if the robot is close to the wall, the fuzzy value will be larger when the robot is close to the wall and smaller when the robot is far from the wall. Do Exercise 2 from this module, but you don't need to hand in anything for this.

Now load the BBWander.py program (the code is also attached to this lab). Notice that the code for a behavior based brain is different than the code for a direct control brain. You'll write classes of Behaviors and States (notice that you're importing from pyro.brain.behaviors – a good thing to do is to look at the code in this file to see the internals).

The combination using the fuzzy rules can be found in the update method of the Avoid class. There are 4 fuzzy rules. Write up an explanation of how these rules are working to hand in with your lab.

While running BBWander.py in simulation, select brain from the view menu. You will be able to watch the fuzzy rules and how much each contributes to the overall behavior of the robot.

*(over)*

## Part II: Writing Behavior Based Code Using Fuzzy Rules

In Lab 2, you wrote a direct control brain that could follow walls on the left and the right. Now you will write a behavior based brain to follow walls. Break your wall following code into rules for following on a side and staying safe in front. You should also be able to relocate a lost wall, as most of you did with flags in Lab 2.

Does the behavior of your behavior based wall follower differ significantly from your direct control wall follower? Explain your answer.

***What to turn in:*** For this lab, you need to turn in your written explanations of the fuzzy rules in BBWander, your commented code for the behavior based wall follower, and a discussion of the differences between your direct control wall follower and your behavior based wall follower. You also need to show me your wall following code working on the robot.