

# LAB 6: MOBILE ROBOTS: COORDINATION

## Overview

The objective of this experiment is to demonstrate an understanding of coordinated motion of autonomous mobile systems and the exchange of real-time measurements and other data through a wireless network.

During the two weeks dedicated to this experiment you are to use two mobile robots (Mobots) to perform "Convoying" and "Formation Control".

## Convoying

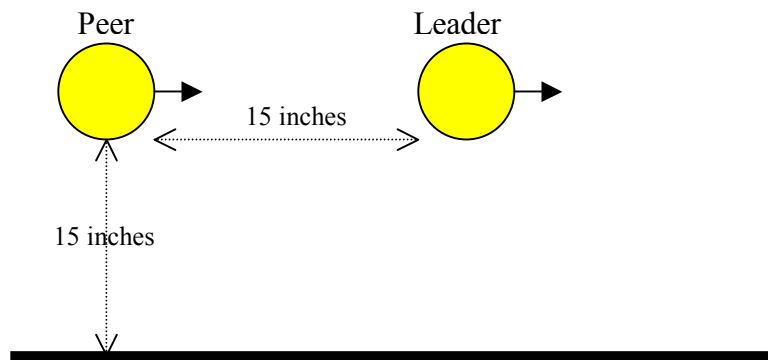


Figure 1. Demonstration for convoying

We have two goals in this task.

The first goal is to detect the "leader" robot (Mobot4), which will be moving at an unknown speed in front of your robot, the "peer". The leader will be provided by the TA's.

The second goal is to match the speed of the peer robot to the leader's speed. However, you should also keep in mind that the leader requires its peers to have a constant distance between them. In other words, the peer robot has to follow the leader such that the distance between them is equal to a constant determined by the road conditions (In this experiment, it is equal to 15 inches). This means that you should change the speed of the peer robot around the speed of the leader to achieve a constant distance with it.

You will be using a forward-looking sensor. You should exercise this sensor and know its limitations. The output of the sensor is saved in the global variable *IR\_front* and updated periodically.

You may also use the transceiver to exchange data with the leader who is willing to provide you with any data you need. (You can look at the example given in transceiver Appendix)

## Formation Control

Until this step, you should have had PI speed controller, steering controller and on/off wall following controller. You will use these controllers in order to get your mobile platform to go *in formation*. In this case, the formation we demonstrate is side by side motion with the mobile robot 4.

Create and demonstrate the following scenario:

1. Mobot 4 is moving at a certain speed profile (Mobot 4 will be supplied to you with the program uploaded).
2. Your mobile robot begins its motion parallel to the mobot 4. However, it doesn't need to be exactly at the left of the mobile robot 4.
3. Mobile robot 4 is sending its orientation (1 byte) at 5 Hz and its position (x and y coordinates which are totally 4 bytes) at 1Hz.
4. Your mobile robot should take the data sent by the mobot 4 and determine its orientation and speed profile. After it comes to the left of mobot 4, it has to go in this configuration.

As you see from the scenario, you need to combine the speed controller, on/off wall following and steering controllers to achieve the task. The setting for the scenario is illustrated in the Figure 2..

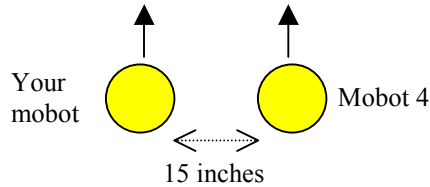


Figure 2. Demonstration for Formation Control

The readings of the right-side sensor are stored in the variable *IR\_distance*. The code that is necessary to receive the orientation and position of mobile robot 4 is not complete. We expect you to write the missing code by examining the example about the transceiver.

## Experiment Procedure

1- Decide which measurements are necessary to implement column following. Then, design a basic controller using the speed and steering controllers developed in the last experiment. Discuss your controller in your report.

2- Tell the TA's which data you need from the leader if any. Make sure you obey the transceiver protocol given in the transceiver Appendix.

3- Implement the designed controller in Code Composer and test your design under following conditions:

- a) The initial distance between your robot and the leader is 15 inches.
- b) The initial distance between your robot and the leader is 5 inches.
- c) The initial distance between your robot and the leader is 25 inches.

Save *IR\_front* measurements and include them in your report.

4- Develop a formation control algorithm. Then, implement the controller as explained in the Formation Control section above. Demonstrate your program under the following conditions:

- a) The initial distance between your robot and the leader is 15 inches.

- b) The initial distance between your robot and the leader is 5 inches
- c) The initial distance between your robot and the leader is 20 inches.
- d) The initial distance between your robot and the leader is 20 inches, and Robot 4 is 20 inches behind of your robot.

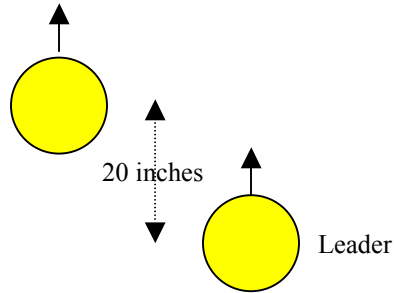


Figure 3. Initial configuration explained in Part d

Save *IR\_distance* measurements and include them in your report. Also include the trajectory of your robot in the report.