CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)

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Project Number

J1311

Project Title

Motor Learning in a Robot: Testing Competing Ideas from Neuroscience

Abstract

Objectives/Goals

Movements need to be accurate for humans and animals alike. Therefore, the method used by the nervous system to generate these movements is important. There are many aspects of motor control, such as direction, speed, and distance of movement. This experiment examines how to control the distance of a movement. Neuroscientists have proposed two possible methods for accurately controlling the motor commands used to generate the distance of a movement: timing and corollary discharge. The timing method uses timers in the brain to measure the amount of time from the start of a movement to determine when to stop. Alternately, the corollary discharge method uses a copy of its own motor command to estimate the distance traveled in a movement in order to decide when to stop.

Methods/Materials

In order to perform a realistic test of these two methods, I needed to 1) implement each method in a separate program to control a robot, and 2) test the programs in a challenging task. Each program was written in RCX code, and downloaded into the LMRIS 2.0 robot, called Roverbot. The challenging task was to make it learn from a single experience to stop before it hit an object. During the learning experience, the Roverbot traveled forward on a track until hitting a wall. During future trials, it traveled a distance that was based on the motor control method.

Results

After testing the two methods in a robot, I found that corollary discharge is a more consistent method than timing when there are random variations in the motor#s commanded speed.

Conclusions/Discussion

Although neuroscientists propose that both methods are used by the brain to control the distance of movements, this data supports the corollary discharge method by showing that movements would be more accurate if the brain used corollary discharge rather than timing. The data also suggests that corollary discharge would be helpful in building robotic devices and possibly prosthetic limbs.

Summary Statement

This project uses a robotic device to test the hypothesis that corollary discharge is more consistent than timing in controlling the distance of a movement where motor commands vary.

Help Received

Dad helped do background research and advised during program development; Mom helped put together board; Mr. Gardinier gave feedback on project ideas.