Percent Error
Teacher Guide

Overview

Students will play the part of engineers who are creating a robot for an exploratory mission. Their job is to determine the most accurate settings for the robot to travel a measured distance, in a straight line, from one point to another.

Beginning with a sample Macro, students will conduct tests, document the accuracy of the program, and calculate a percentage of error. They will then make adjustments to delay (time) and speed variables to improve accuracy and reduce their percentage of error, tracking and graphing their results to use as evidence when explaining how they reduced their percentage of error.

Estimated Time: 1-1.5 hours

Student Organization:

Objectives

Students will:

- Think critically about a real-world engineering problem.
- Improve the performance of a robot by modifying its programming.
- Complete an iterative testing process and document results accurately.
- Use concrete data gathered and documented throughout the testing process as evidence that they have achieved an engineering goal.

Materials Needed

- Measuring tape
- Electrical or masking tape
- Calculator
- Sample Program
- Student Worksheet

FAQs:

Q: What factors could affect the robot's accuracy?

The amount of time the robot rolls, its heading and speed, or raw motor power can affect its accuracy moving from one precise location to another. This activity uses a basic Macro. Students who are ready for an additional challenge can create a course for their robot to follow that is angled instead of straight and work with aiming and directional variables.

Encourage students to test adjustments one variable at a time, while keeping other variables the same throughout their trials. Their final program may include adjustments to several variables, but they should be able to provide evidence that they conducted research into the effects of adjusting one variable in several ways to understand how it works, before synthesizing those adjustments into a program that is effective overall. Results can be difficult to interpret when more than one variable is adjusted at a time.

Another option is to divide the class into two groups, where each group experiments with a different variable. At the end of the testing period, students can share their results, talk about which variable adjustments contributed to the reduction of percent of error.

Q: How should students represent their data?

Students can manually create graphs that demonstrate how adjusting their variable affected percentage of error, or input their values into spreadsheet software and use the tools available there to create different representations.

Q: What variables will my students work with?

In MacroLab, the distance Sphero travels is controlled indirectly by adjusting variables for Delay and Speed. Settings for Heading and Raw Motor Power can also be investigated to improve accuracy.

Q: How can I ensure that the robot moves in a straight line?

Because Sphero is a rolling robot, it is important to make sure that trials are being conducted on a flat surface. If the floor is uneven, or textured, it may affect Sphero's ability to travel straight.

NOTE: Remember that Sphero's heading is relative to the user. Each time Sphero is turned on, the tail light needs to be "aimed" to set the direction that will be used for a heading of 0 degrees.

Extension:

Encourage students to experiment with different representations of their data or students may complete their graphs manually if spreadsheet software is not available.

Have students complete the same testing and documentation process on a different type of terrain (e.g., up a slight incline, over thick carpet, across a rough concrete parking lot, or through sand) and consider whether speed or power may be more advantageous in different circumstances to improve precision.

Have students complete the same testing and documentation process to create a program that follows a precise 90 degree turn or have Sphero follow a curved line.