Graphing distance

Teacher Notes

PHYSICS
Motion in one direction

Driving Question:
How do you graph motion?

Applied Technology: Data-logging

Student Level: Middle School Level (11-14)

Duration: 1 lesson period

Recommended Settings: Student Investigations

Learning Objectives

- To use a motion detector to record motion of one's own walking
- To explore motion graphs produced by walking in front of the motion detector
- To interpret the resulting motion graphs

Didactical Approach

In this activity students record motion graphs. They are asked to walk in front of the motion detector and a graph of distance vs. time is being plotted real-time on the computer or a data-logger screen during their motion. Students are asked to interpret resulting graphs. Questions about the graphical representations of *fast, slow, away and towards* the motion detector are asked.

In the second part of the activity students are asked to walk to create a motion graph, which looks like a letter M or a letter W.

Common student difficulties:

– Confusing the graphical representations and motion paths of real objects e.g. plotting position and velocity as the path of motion.

Concepts learnt in this activity:

– Position, distance, distance vs. time graph, motion graph.

Materials

– USB Motion Detector e.g. CMA €Motion

Or

– Data-logger to which a motion detector can be connected and Motion Detector e.g. CMA CLAB and Motion Detector BT55i.

Procedure

- Start the Coach program and open Coach Activity ‘Graphing distance’.
- Connect €Motion to an USB port of your computer or connect the motion detector to your data-logger.
- The activity is prepared to display ‘distance versus time’ graph.
- The measurement settings are: measurement time - 5 minutes, sampling rate - 4 per minute.
- Let the students perform measurements.

Tips for using Motion detector

- For accurate measurements let students hold a large, flat object (e.g. a large book) as a reflector. If you have an irregular reflecting surface, the waves will sometimes be reflected back to the transducer, and sometimes not. The result will be erratic (spikes).
- The motion detector will report the distance to the closest object that produces a sufficiently strong echo; objects, in the cone of ultrasound, such as chairs and tables, can be picked up by the motion detector.
- If you have trouble with a stationary object causing unwanted echoes, try placing a cloth over it. This minimizes the sound reflection.
- If there is another source of ultrasonic waves in the same frequency range (like motors, fans, air track blowers, the sound made by air exiting the holes of an air track, and even students making loud noises), this can cause erroneous readings.

Questions and Assignments

- What is your initial position?
- What is your walked distance?
- What is the difference between moving slowly and moving fast towards the motion detector?
- What is the difference between moving slowly and moving fast away the motion detector?
- What are the steps to create a ‘M’ – motion graph?
- What are the steps to create a ‘W’ – motion graph?

Data Analysis

This experiment introduces the motion sensor in an informal manner, which has proved very successful with middle and high school level students.

As the student walks forwards and backwards, in front of the motion detector, the immediate display of the distance-time graph allows the student to associate clearly the shape of the graph with the type of motion. The intimate connection between the personal movement and the data appearing on the screen provides a compelling experience for the student, which has excellent potential for developing skills with graphs. With suitable

prompting from the teacher, the student may be led to understand better how to interpret the shape of the graph. A valuable extension of this activity is ‘Match the graph’ activity.

It is recommended that students save their data after each measurement.

Resources

Coach Activity: Graphing distance.cma7

Coach Result: Graphing distance - letter M.cmr7

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