Motion graphs

One of the most effective methods of describing motion is to use graphs of motions: graphs of position (distance) vs. time, of velocity vs. time and of acceleration vs. time.

The CMA Motion detector together with the Coach software can be an effective means of teaching students to learn basic concept of kinematics.
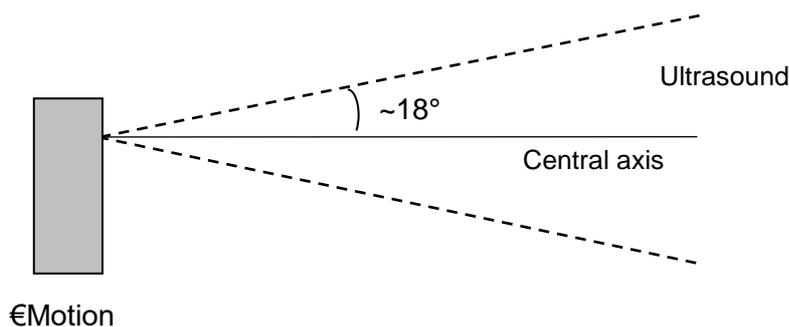
CMA Motion detectors

CMA Motion Detectors (€Motion 010, Motion detector 0664, Motion detector BT55i and Motion detector ML26m) are ultrasonic motion detectors that measure the distance between the detector and a (moving) object.

The motion detector transmits short pulses of high frequency sound (approx. 50 kHz), then detects the reflected pulses. The Coach program measures the time between the transmitted and received pulse and using the speed of sound in air, it calculates the distance to the reflecting object.

The motion detector can accurately detect objects between 20 cm and 6 to 10 m, depending on the size, shape, orientation and surface of the object that is detected.[1] It detects the closest object in a roughly 18° cone.

While the motion detector is operating, a ticking sound is heard.

€Motion

The sampling frequency used in experiments with a motion detector is limited by the speed of sound in air (about 340 m/s): if e.g. a distance of 10 m is measured (such a large distance can only be measured for large, flat objects), the sound pulse takes about 59 ms

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[1] The maximum detection distance of 10 m can only be reached under good conditions, i.e. for a large, flat surface that is perpendicular to the Motion detector.

to travel from the motion detector to an object and back. This means that if a sample frequency of more than 17 Hz is used, a new sound pulse is emitted before the previous one is received, leading to erratic readings. The maximal frequency is also limited by the conditions of the experiment.

Typical sampling frequencies are:

- 1 m range – 40 Hz
- 2 m to 6 m range – 25 Hz
- 6 m to 10 m range – 10 Hz.