
€MOTION

USER'S GUIDE



CENTRE FOR MICROCOMPUTER APPLICATIONS

<http://www.cma-science.nl>

Short description

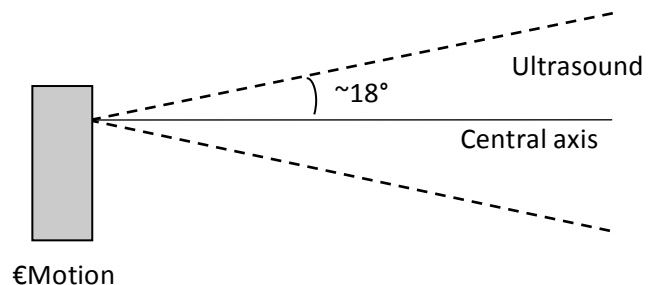
The €Motion is an ultrasonic motion detector that connects directly to a computer through a USB-port. No additional interface or adapter is needed.

The €Motion measures continuously the distance between the interface and an object. While it is operating, a slight clicking sound will be heard. The €Motion has mounting threads on the bottom and both sides of the unit which can be used to mount the €Motion to a stand.

The minimum of the range of the €Motion is 0.20 meter. The maximum of the range is 6 to 10 m, depending on the size, shape, orientation and surface of the object that is detected. Note that 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.

How the €Motion works

The €Motion emits short bursts of ultrasonic sound waves from the transducer. These waves fill a cone shaped area about 18° off the axis of the centerline of the beam. The €Motion then "listens" for the reflected ultrasonic waves returning to it.



By timing how long it takes for the ultrasonic waves to make the trip from the €Motion to an object and back, the distance to the object can be determined (based on the speed of ultrasound in air).

Note that the €Motion will report the distance to the closest object that produces a sufficiently strong echo. Object such as chairs and tables in the cone of ultrasound can be picked up by the €Motion.

For accurate measurements the object should have a flat front perpendicular to the line between the €Motion and the object.

Tips on getting good results with the €Motion

- Check for a stationary object (chair, table, etc.) in the cone of the ultrasound. This object may be detected when you are trying to study an object further away, it may not take a very large object to cause problems. If you have trouble with a stationary object causing unwanted echoes, try placing a cloth over it. This minimizes the sound reflection.
- Also note the cone of ultrasound extends downward from the center line. This can cause problems if you are using the €Motion on a horizontal surface. In these cases, aim the €Motion slightly upward or place it somewhat higher above the surface.
- Note that the sampling frequency 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 signal takes about 59 ms to travel from €Motion to

object and back to the €Motion. 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.

- 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.
- If the room in which the €Motion is being used has a lot of hard, sound-reflecting surfaces, you can get weird effects caused by the ultrasound bouncing around the room. Standing waves can be set up between the €Motion and a sound reflector. Try placing a cloth horizontally just in front of and below the €Motion. This sometimes helps eliminate ultrasound that is "skipping" into the €Motion.
- If you are studying people moving, have them hold a large, flat object (e.g. a large book) as a reflector. If you have an irregular reflecting surface, sometimes the waves will be reflected back to the transducer, and sometimes not. The result will seem erratic.

Connecting €Motion to the computer

€Motion works only on Windows computers. To connect €Motion to your PC computer simply plug its USB-plug into a free USB-port of the computer. For some Windows systems the low-level driver has to be installed. For this purpose, separate MSI installations are available. Follow instructions given in your Coach Installation Guide or at our website <http://www.cma-science.nl/coach-7-installations>.

Calibration

The €Motion is calibrated by the driver of the interface, so applying another calibration is not necessary. However, the speed of sound in air is dependent on the temperature and humidity of the air. So, for very precise measurements, the €Motion can be re-calibrated at the time of measurement by applying an additional calibration in Coach.

Suggested experiments

The €Motion can be used for studying a variety of motions including:

- students walking toward and away from the €Motion,
- objects in simple harmonic motion, such as a weight hanging from a spring,
- pendulum motions,
- carts rolling on a table or (air) track,
- falling objects.

Technical data

<i>Range min.</i>	0.2 m
<i>Range max.</i>	6 - 10 m (depending on object size, orientation, and surface)
<i>Maximum measurement frequency</i>	100 Hz
<i>Resolution</i>	1 mm
<i>Typical accuracy</i>	± 1.5 mm
<i>Ultrasound frequency</i>	49.4 kHz, 15 cycles / pulse
<i>Aperture = (top angle) / 2</i>	Approx. 18° with respect to the central axis
<i>Power supply</i>	5V supplied by USB (no adapter needed)
<i>Speed of ultrasound in air used to calculate distance</i>	340 m/s
<i>Connection</i>	USB plug

Warranty:

The €Motion is warranted to be free from defects in materials and workmanship for a period of 12 months from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

Note: *This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.*

Rev. 22/11/2016