Ultrasonic Ranger *VS*
for the LogIT Microsense® system

Overview

The Microsense® Ultrasonic Ranger VS is an intelligent ultrasonic motion and position sensor which measures precise distance.

It works by sending an ultrasonic pulse at a target and waiting for the return echo - the time taken to receive the echo, given the speed of sound, equates to twice the distance between the Ranger and the target. This is controlled and measured by a microprocessor built into the Ranger which allows fast real time plotting and logging and resolves to better than 0.2mm.

The LogIT Ranger can be plugged directly into any sensor socket of a LogIT family data logger and can work alongside other sensors using standard data logging software. Because of its very high resolution changes due to temperature can be simultaneously logged by using a temperature sensor in another sensor socket.

In Use

The Ranger VS is very easy to use. Just plug it into any sensor socket, connect up your LogIT and go!

Around the ultrasonic transducer are a set of 8 LEDs. These are used to indicate the detection of an object and will rotate clockwise/anticlockwise depending on which direction the object is moving.

These LED's aid in the setting up of experiments as an object can be aligned correctly before logging begins.

A hole is provided in the base plate which allows the Ranger VS to be mounted in different locations.

The power to the sensor is supplied by the LogIT data logger so no batteries are required.

Specifications

Standard Range:	200mm to 5000mm
Alternative Range (via software):	0 to 50ms
	0 to 10000µs
Accuracy:	Better than +/- 3%
Resolution:	0.2mm

The resources shown overleaf are also available in PDF form at www.logitworld.com

Designed and manufactured in Great Britain.

Instructions & Resources

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Care

Do not expose Ranger VS to moisture or corrosive gases.
Do not allow any objects to pass through the grill of the transmitter/receiver.
Do not disassemble this sensor.

Frequently asked questions.

Q. Can I measure the speed of sound in air with the Ranger?
A. Yes. This is done by selecting the echo time scale as opposed to the distance scale within the logging program. For LogIT Lab you require version 4.0Xx as a minimum which is available from our downloads page at www.logitworld.com

Since the echo time is the time taken to travel to the object and back, divide by 2 to obtain the time taken to reach to object. Convert to seconds and then substitute into the following equation:

Speed of sound (m/s) = Distance for echo to travel / Echo time (s)

The Distance for echo to travel can either be measured using conventional rulers and tape measures, or use the Ranger itself.

Students can check their results by using a temperature sensor, measure the temperature of the room (∂ in ºC) and substitute into the following equation to obtain the speed of sound.

Speed of sound (m/s) = 331.3 x $\sqrt{(1 + (\partial /273.15))}$

Q. The Ranger struggles to see the object being used?
A. This can be caused by a couple of issues
  i) The target is too small. Try using 10cm x 15cm as a minimum if using an air track and by using the LED motion display to make sure the Ranger can 'see' the target along the whole length of the track. Solid flat surfaces work best as soft clothing can absorb the sound waves.
  ii) The target is not reflecting back the sound wave properly. If using the Ranger to track the movement of people, get the person to hold a piece of card as a target or similar as the sound waves can be absorbed by clothing and not echoed back to the Ranger giving false reading.

Q. My results have spikes and 'odd' readings?
A. This can occur when an echo is lost and the wrong echo is received by the Ranger. To avoid this happening, try doing as mentioned above and also bear in mind that the sound wave is very directional so good alignment is essential.

Q. Can I use more than one Ranger at a time?
A. Yes you can but you must ensure that they are not too close together as they will hear each other's echo's and cause false readings.

Instructions & Resources

Tracking a moving car (Distance/Time graphs)

Subject: Physics

Overview:
This is a simple example of how the Ranger can be used to track a moving object. In this example an air track is going to be used so that the Ranger can follow a moving car and plot the distance/time graph.

Aim:
To simply show how a moving object can be tracked using the Ranger VS and an air track as shown.

Equipment required: LogIT Datalogger.
Datalogging software, computer.
LogIT Ranger VS.
Air track (a ramp can be used just as well)
Clamp stand.
Black card (10cm x 15cm square).
Modelling clay or similar.
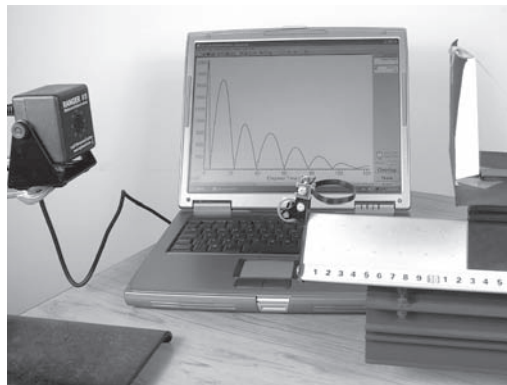
Hazards:
Take care whenever investigating impacts that the equipment is suitable for the task.
Always check your local regulations or the school advisory service (such as CLEAPSS or SSERC in the UK) for guidance on the use of any hazardous material.

Method:
1. Connect the Ranger to the data logger.
2. Connect the data logger to the computer.
3. Place the Ranger at one end of the air track or ramp.
4. Align the Ranger using the LED motion display so that the object is seen along the full length of the track.
5. Start the data logging software.
6. Start the object moving and collect the distance/time graph data.

Results:
• What does the graph show?
• Did the distance/time graph look correct for the movement of the object?
• Can you explain any odd looking data on the graph?
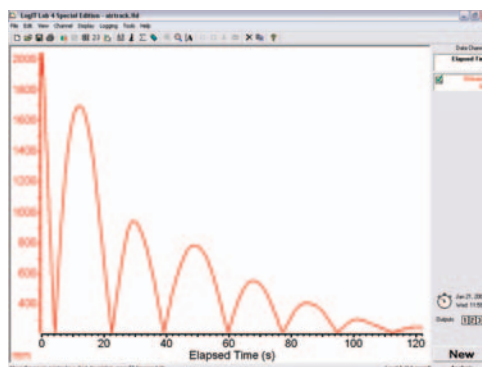
Going further:
How would you derive the speed of the object from the data?
Can you derive acceleration? If so, how could you do it?

Now that this simple procedure has been performed, try investigating what happens to the distance/time graph when a collision occurs. Use an additional car to collide with or use different thicknesses of foam to simulate a wall and track what happens to the object.

Track a person in the lab. Ask some students to make a distance/time graph and then without the volunteer seeing the graph, ask a team of students to direct the person to follow the path. eg. forward, stop, wait, forward etc. The idea being to overlay a new plot exactly on the old one. Closest is the winner!

Simple Harmonic Motion (SHM)

Subject: Physics

Overview:
A simple experiment to monitor the simple harmonic motion of a spring using the LogIT Ranger VS.

Aim:
By using a Ranger and spring, monitor the SHM of a spring.

Equipment required: LogIT Datalogger.
Datalogging software, computer.
Ranger.
Spring and masses.
Black card 10cm square.
Modelling clay or similar.
Clamp stand to spring.

Hazards:
Children should be supervised at all times.
Always check your local regulations or the school advisory service (such as CLEAPSS or SSERC in the UK) for guidance on the use of any hazardous material.

Method:
1. Fix the card onto the base of the mass and hang onto the spring using the modelling clay.
2. Hang the spring from the clamp stand.
3. Place the Ranger at least 300mm from under the card. (Do not allow the base of the card to get within 200mm of the ranger as this is too close for a reading.)
4. Connect to the data logger and then to the computer,
5. Start the logging software.
6. Gently pull down the mass and release. Remember to use small oscillations.
7. Start logging.
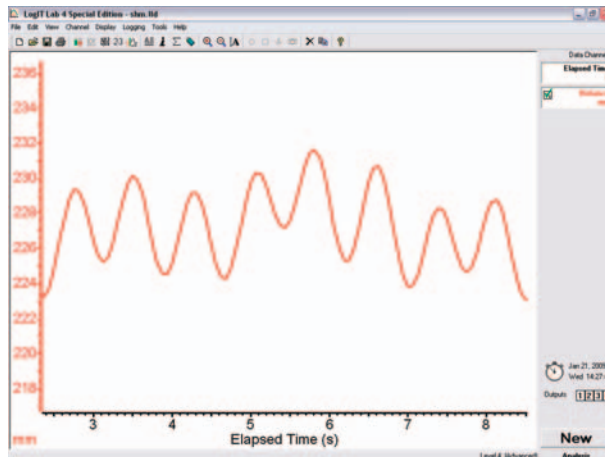
Results:

What do the results show?
What can you derive from the shape of the graph?

Going further:

Investigate varying the mass. What effect would this have on the recorded data?
Investigate starting at a different displacement. Does this effect the recorded data in any way?
How might you investigate the extension of a spring with increasing mass?
How else might you investigate SHM using the Ranger?