

Lab: Resolution of Surfaces

We usually determine the surface features of macroscopic objects just by looking at them with our eyes. We can think of our eyes as sensors that collect visible light bouncing off the objects. Our brains then process the “data” from our eyes and interpret them to put together an image for us to use.

What happens when we can't use our eyes because the object is too small? In that case we must use a different detector from our eyes and a different processor from our brain to put together an image. We will simulate such a case in this activity and determine the limitation of such measurements.

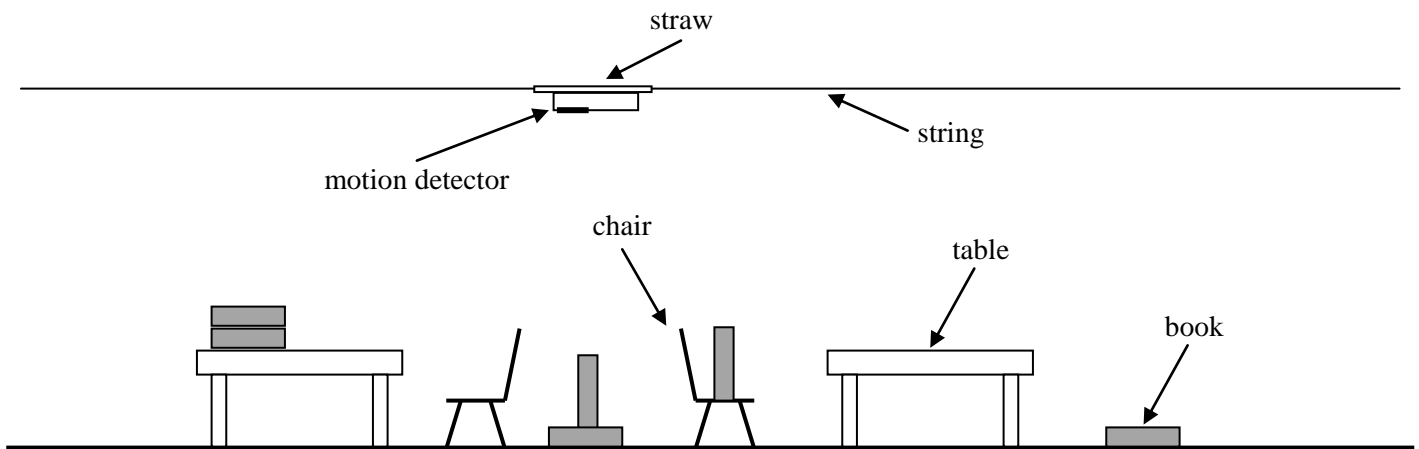
Materials

desks, chairs, books string motion sensor straw tape

Pre-lab

Your teacher will set up several objects (desks, chairs, books) in a line across the classroom. Your job is to tie the string across the room about 0.5 to 1 m above the highest feature in this line of objects. Be sure that the string is firmly attached at the ends so that it can support the motion sensor.

Tape a straw to the bottom of the motion sensor and put the string through it so that the sensor can slide across the room on the string. The sensor should be pointed downward so that it measures distances down to the nearest surface. The complete setup is shown in the diagram below.

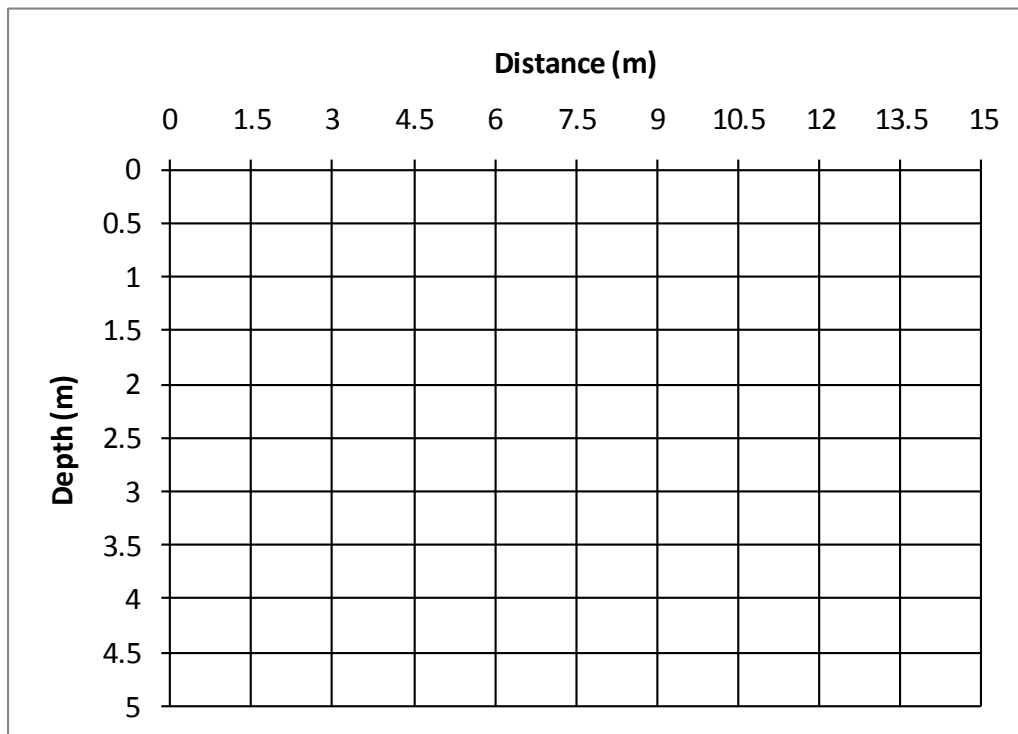


We will position the motion detector at 1.5 m intervals and use it to measure the depth to the feature below it, be it a book, chair, table, or the floor itself. This will provide a profile of the features of the room. We will then repeat the profile measurement two more times but at smaller intervals (1 m and 0.5 m) between depth measurements.

Data

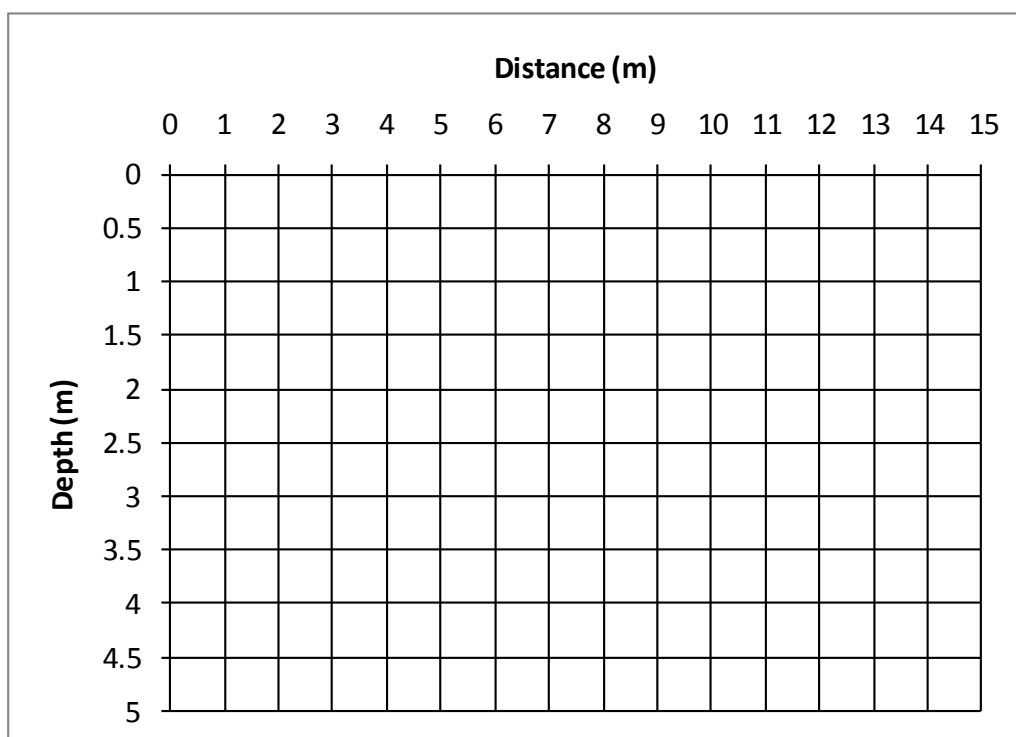
1. Use the motion detector to measure the profile of the room at 1.5 m intervals. Create a chart below to record your data. Remember that a good data chart should have the following characteristics:
 - each row or column heading is clearly labeled with the type of data listed
 - the unit of measurement for each heading is shown in parentheses

Draw the profile on the axes below. Your profile should be drawn as a series of horizontal lines extending over each 1.5 m interval. For example, if you measured a depth of 2 m at a distance of 4.5 m from the starting end of the string, draw a horizontal line from 4.5 to 6 m at a depth of 2 m on the axes.



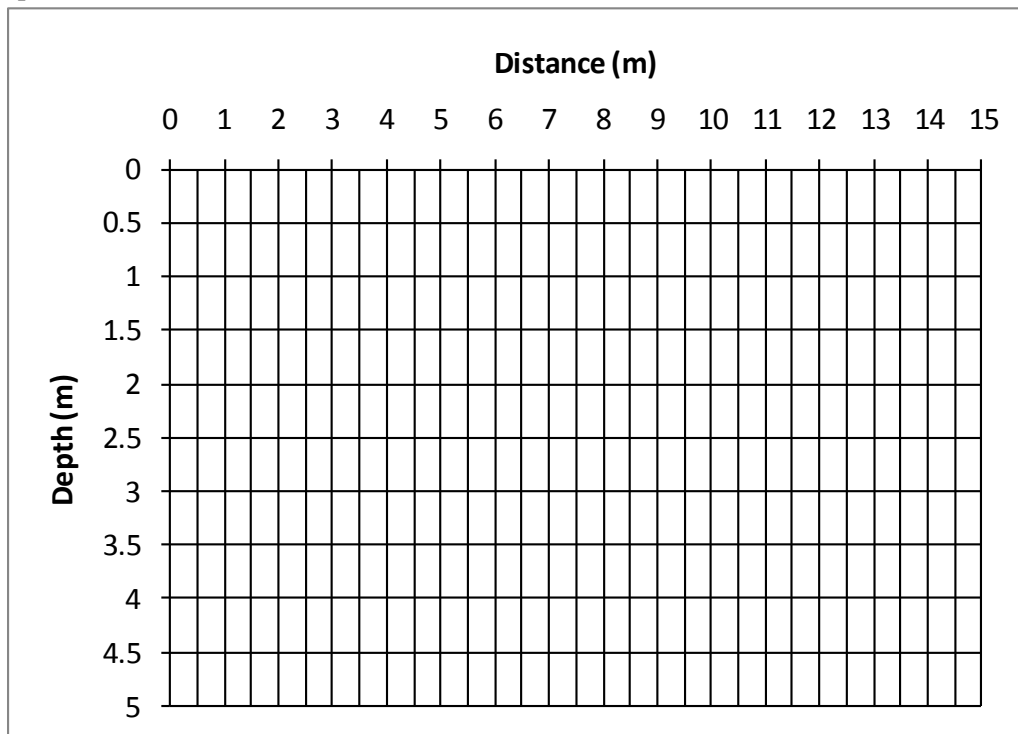
2. Now use the motion detector to measure the profile of the room at 1 m intervals. Create a chart below to record your data.

Draw the profile on the axes below.



3. Use the motion detector to measure the profile of the room at 0.5 m intervals. Create a chart below to record your data.

Draw the profile on the axes below.



Analysis and Conclusions

1. Compare and contrast each profile measurement.
2. Does the sensor detect all the objects? Why or why not?
3. The *resolution* of a surface profile technique is the minimum size feature that it can detect. What is the resolution of our technique in this lab?
4. What are some other methods we might use to examine the surface if we can't see it? What would limit the resolution of these methods?