Range Finder Characterization Worksheet

Range finders, aside from cameras, are the bread-and-butter of robotics. They have a wide variety of uses and are immensely useful! But there are several different kinds (MASLab stocks short and long range infrared rangers, and ultrasound sonar rangers.) To decide which kinds of sensors are good for you, we need to know more about them. We want to determine the following characteristics:

1. Minimum and maximum useful distance
2. Relationship between distance and output.
3. Noise characteristics
4. Beam pattern, sensitivity
5. Repeatability both for the same sensor and for different sensors
6. Failure modes

In order to test the sensors, you'll need an OrcBoard, an OrcPad, and of course the sensor and a cable for the sensor. You can test the sensors without writing any code using the OrcSpy utility, included in the maslab.jar file. It can be invoked by simply typing:

```
java –jar maslab.jar <IP Address of Eden>
```

OrcSpy displayes a small panel for every I/O pin on the OrcBoard. Recall that each of the pins on the OrcBoard can be operated in several different modes; use the little triangle pop-up menu to configure the correct mode. See the OrcManual for a list of which mode possibilities are possible.

OrcPad Calibration

If you haven't used your OrcPad before, you may want to calibrate the joystick (to make sure that it's centered.) To do this, hold down the menu button for *four* seconds. At the first screen, move the joystick through the full range of motion: the utility is trying to find the maximum and minimum values for the x and y axis. Then release (center) the joystick and hit menu. The second screen will allow you to adjust the voltage measurement. Use a multimeter to determine the precise input voltage then adjust the display appropriately. Then hit menu until it says "configuration saved". The configuration data is saved in non-volatile memory, so the settings will be remembered even if power is disconnected. (Firmware updates will erase the settings however.)

What to do

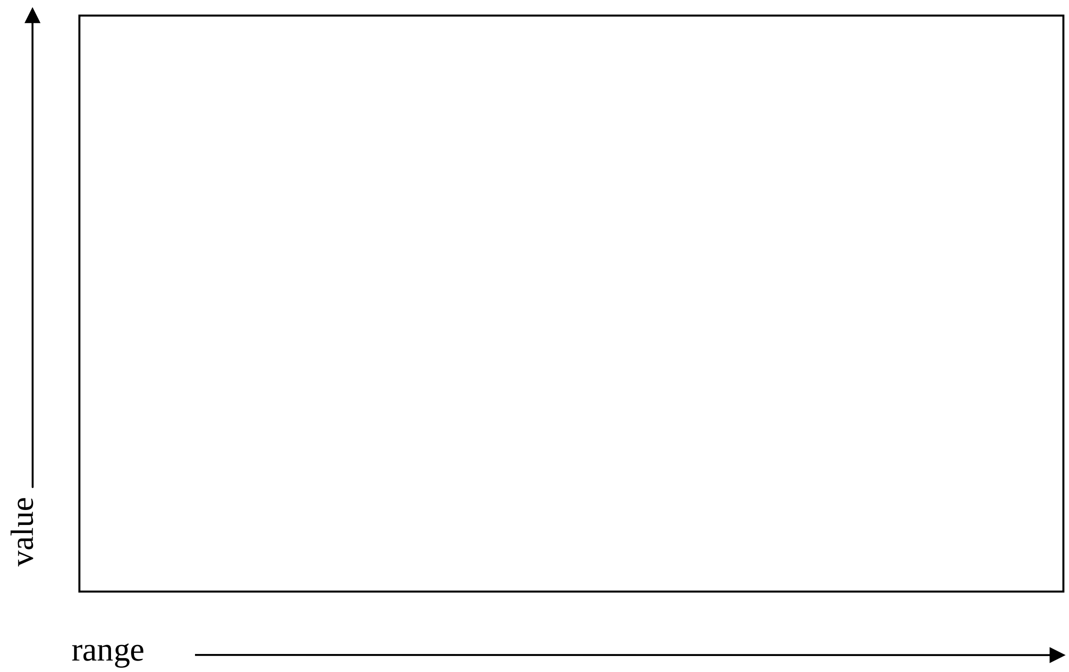
Evaluate our three different range finders with the help of this worksheet. Work on one sensor at a time with your whole team so that you can *all* get a feeling for *each* sensor. So grab a sensor and get going! You may need to make a cable for your sensor—look for the appropriate instruction sheet.

Type of sensor (circle one):		
Long-range IR	**Short-range IR**	**Ultrasound Sonar**

1. Find the output values for about 10 different distances in the range you found in step one. Be sure to measure a number of nearby distances.

	Distance	Measured Value
1	0” / 0 cm	
2	1” / 2.5 cm	
3	2” / 5 cm	
4	3” / 7.5 cm	
5	5” / 12.5 cm	
6	8” / 20 cm	
7		
8		
9		
10		
11		
12		
13		

Now make a sketch of the relationship between distance and value. (Please put a scale on the axes.)



Consider: if you had a value from the sensor, how would you estimate what the range was? (Is the inverse function very simple? Would you fit a function? Would you use a look-up table?)

2. What is the minimum range where the sensor seems to work properly? What is the maximum range where a change in distance results in a measurable and reasonably consistent change in output?

Minimum range:	**Maximum Range:**

Consider: if the minimum range is fairly long, how might you deal with it, so that you don't interpret the erroneous value as a legitimate distance?

3. How wide is the beam width?

   Pick a distance that is in the sensor's area of good operation. Take a small object, such as a cardboard tube balanced on its end, and determine over what arc the sensor still detects it. i.e., the sensor should definitely pick it up when the target is directly in front, but how about when the target is off to the side some?

Consider: If you were using the sensor to create a map of the playing field, would you want a narrow or a wide beam width, and why?

Consider: If you had a "bad" beam width for creating a map of the playing field (as above), how might you compensate if you really needed to build a map? What if you had multiple sensors, would that help?

Consider: If you wanted to build a map, how would you obtain the range measurements all around you? (Many sensors, rotate the robot, rotate the sensor?)

Consider: If you were using the sensor to detect any object before you collided with it, would you want a narrow or a wide beam width, and why?

Consider: If you had a "bad" beam width for collision avoidance (as above), how could you compensate? If you had multiple sensors, would that help?

Beam width and comments:

4. How noisy/repeatable are the measurements?

   You've had a chance to evaluate this sensor a bit. How reliable do you consider the data to be? Is there a lot of noise (i.e., the output value varies quite a lot for a fixed distance)?

   See if you can borrow an identical sensor from someone else. Spot check the performance of it. Do you get the same values as you did before?

Comments on Noise/Reliability/Consistency:

5. When things go wrong

   Position a nice flat target surface (like a book or playing field wall) at a sharp angle.

Is there an angle at which you start getting crazy values? What do you think is happening?

Comments on angles:

6. When things go wrong (again)

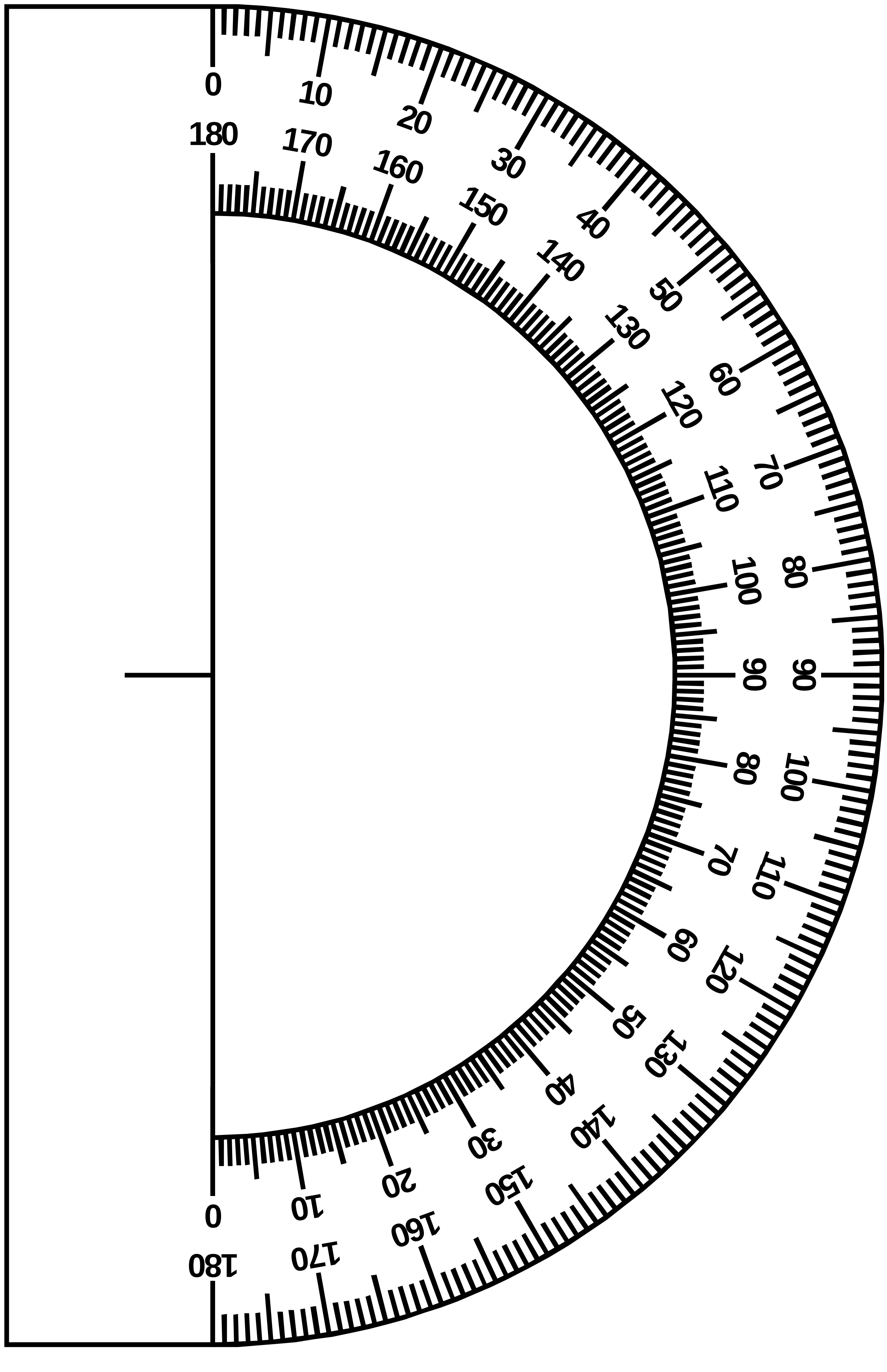
   What can you do to make the sensor misbehave? Try a bunch of things. If it's an optical sensor, try different lighting (darkness/bright lighting/light shining at sensor), if it uses sound, can you get someone else's ultrasound sensor pulse to interfere with yours?

Comments on other failure modes:

7. Do you like this sensor?

   Consider: What do you think of this sensor? Do you think it's useful? What applications do you have in mind?

   After taking a look at all the sensors, be sure to comment in your lab journal about what sensors you think you might like to use, and why.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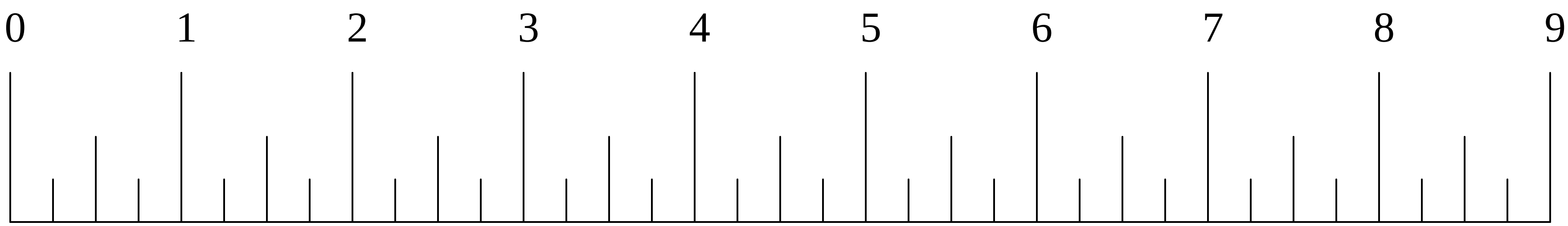
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0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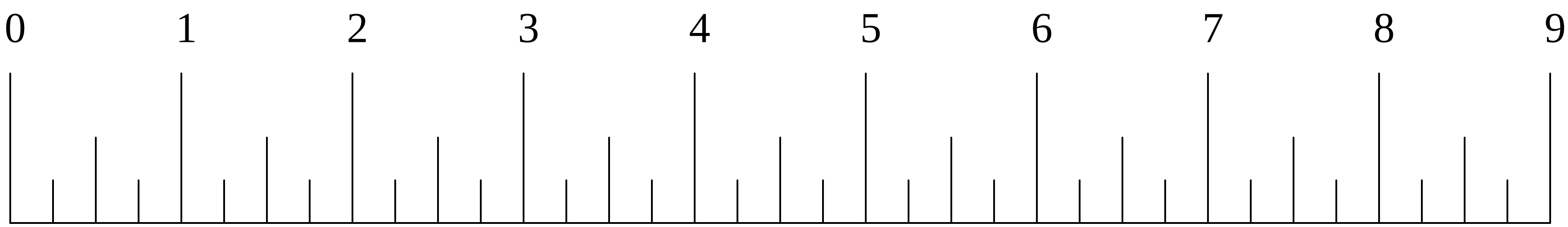
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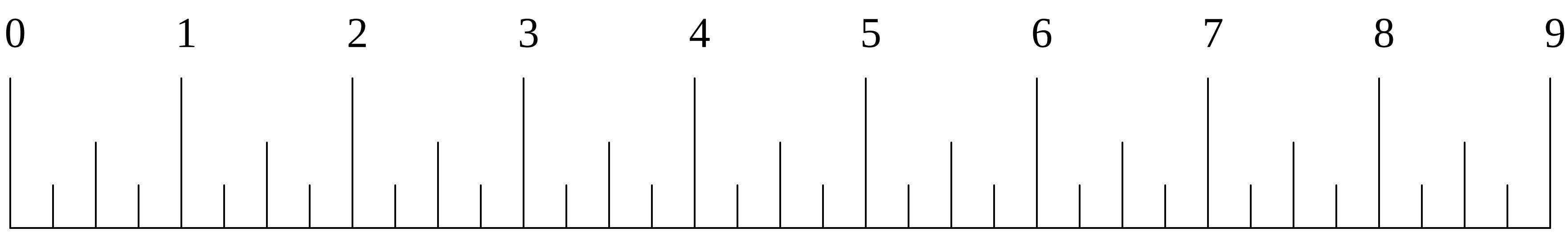
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