Laser Rangefinder Validation Report

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The Laser Rangefinder is an instrument that we used to measure distance. We performed our tests of accuracy and precision by measuring a distance with the tape measure and comparing it to results from the laser rangefinder.

LRF.pdf

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Validation Report Briefing

Purpose: The purpose of this experiment is to test a laser rangefinder for its precision and accuracy, as well as find it's resolution.

Preliminary Questions: Will surfaces that aren't 90degrees make a noticeable difference compared to surfaces that are or close to 90degrees? Will other light sources (such as car lights) affect readings taken from the LRF? How close can an object get to the line of sight of the LRF before interrupting the beam?

Method: Measure an actual distance of at least 100m on a flat, 90degree surface. Use different color poster boards as targets for the range finder to detect and use a prop such as a stool for keeping the range finder still and on target. Take the measurement at a certain distance five times, then change the distance of at least 30m and take five more measurements. Record these measurements and average them in one measurement, then compare the average to the actual distance to find the accuracy.

Data: See attached page.

Analysis: The range finder did very well for distance under 100m. After that, measured distances varied depending on how far away it is. Variables that might have affected this is the range finder not detecting the EXACT same spot, which might have been prevented if a stool was provided at the time. Also, the surface measured on was not a 90degree surface and of which was black, making it harder for more accurate measurements.

Conclusion: From doing this experiment we concluded that the LRF could detect things accurately below 100m. From there on, precision and accuracy varied significantly which is most likely do to not using 90degree surfaces. We also conclude that when the range finder is used on the balloon that it will have much more accurate results do to no interferences.

Calculations

Average Measurements:

$$\frac{x}{n} = \text{Average}$$

1. $\frac{(61+61+60+61+58+58+58+61)}{8}$ = **59.57m** 2. $\frac{(40+40+38+40+40+40+39+40)}{8}$ = **39.63m**

3. $\frac{(28+30+30+28+29+29+29+29)}{8}$ = **29m**

Precision:

$$\frac{\sqrt{\sum (x-x)^2}}{\sqrt{n-1}}$$

1. $\frac{\sqrt{(1.43^2 + 1.43^2 + 0.43^2 + 1.43^2 + 1.57^2 + 1.57^2 + 1.57^2 + 1.43^2)}}{\sqrt{7}}$

$= \frac{\sqrt{15.7592}}{\sqrt{7}} = 2.25$ **= 59.57m + or – 2.25m**

2. $\frac{\sqrt{(0.37^2 + 0.37^2 + 1.63^2 + 0.37^2 + 0.37^2 + 0.37^2 + 0.63^2 + 0.37^2)}}{\sqrt{7}}$

$= \frac{\sqrt{3.8752}}{\sqrt{7}} = 0.55$ **= 39.63m + or – 0.55m**

3. $\frac{\sqrt{(1.0^2 + 1.0^2 + 1.0^2 + 1.0^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2)}}{\sqrt{7}}$

$= \frac{\sqrt{4}}{\sqrt{7}} = 0.57$ **= 29m + or – 0.57m**

Accuracy:

$$\frac{x}{\text{Actual Distance}}$$

1. $\frac{59.57m}{60.0m}$ = **99.28 %** 2. $\frac{39.63m}{40m}$ = **99.07 %** 3. $\frac{29m}{30m}$ = **96.66 %**

Average Accuracy:

$$\frac{\text{Accuracy1} + \text{Accuracy2} + \text{Accuracy3}}{N} \qquad \frac{99.28 + 99.07 + 96.66}{3} = \mathbf{98.34\ \%}$$