Test Results Report

for

TeraRanger Evo 60m sensor potential maximum range in varying outdoor conditions

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1 Introduction

The aim of this document is to show the behavior of the sensor in a range of outdoor conditions, which by definition can be far more variable and challenging than many indoor conditions. By considering some of these more challenging operating environments, greater insight into the sensor specification sheet can be gained, notably around the maximum attainable range.

In these tests, the TeraRanger Evo was used with the TeraRanger USB backboard. To help validate the tests, crosscheck tests were also run using the TeraRanger UART/I2C backboard, and on multiple sensors.

The aim of the tests was to examine which factors affect the performance of the TeraRanger Evo 60m outdoors, and to what extent.

2 Setup description

2.1 Test bench description

For each of the following tests described in section 3, the following setup was used:

- The sensor was mounted on a trolley driven along a rail perpendicular to the target. The Sensor was linked to a computer to collect the data. The data was streamed via Hterm terminal software.
- The target was fixed. Only the sensor was moved in relation to the target to change the measured distance.
- The sensor was positioned at a height that guarantees the FoV of the sensor does not point at the floor at a distance of 60m from the target (which is the maximum range of the TeraRanger Evo 60m.)
- The platform on which the TeraRanger Evo is attached can tilt. A level instrument was attached to the platform, to ensure that the sensor is always at a right angle to the target surface.
- A calibrated laser measurement device was attached to the platform, and considered as a benchmark.

2.2 Test objective

- The aim of the test is to start from a distance of 50cm from the target surface, and from there, the sensor will be moved away from the target.
- Measurements are taken every 2 meters until the maximum range is reached in the test conditions.
- The distance read by the sensor is collected and the accuracy of the sensor analyzed in correlation to the near-infrared (NIR) light in the ambient conditions.

2.3 Target description

The tests were run on 4 different targets, as described below. The targets were selected so that they either represent real use case scenarios or put the sensor into challenging conditions where we would expect sensor performance to be impacted by the target surface.

	
Target #1 : metallic door, high reflectivity	Target #2 : grass bump, very low reflectivity
	
Target #3 : Wood wall, low reflectivity	Target #4 : Painted plasterboard

Note: Target #4 was built by Terabee as a control surface and was previously used in controlled indoor conditions. By taking it outdoors we were able to compare results with more random and potentially challenging lighting conditions.

3 Test results

3.1 Target #1 metallic door

#	Illustration	Conditions description	Maximum range achieved
1.0		● Cloudy day ● No direct sunlight exposure on the sensor or on the target, but sunlight is still perceptible.	**19 m**
1.1		● Sunny day, clear sky ● No direct sunlight on the sensor Zone A : direct sunlight on the target Zone B : no direct sunlight on the target, but direct reflection of the sun from the asphalt (sun is facing the door)	**Zone A: 15m** **Zone B: 30m**
1.2		● Sunny day, clear sky ● Direct sunlight on the sensor ● Target in the shadow and no direct reflection from the sun from the asphalt (sun is “behind the door”)	**40m**

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Note: Test cases 1.1 & 1.2 were made on the same day just a few minutes apart. Therefore the environmental conditions can be considered as identical. The two metallic doors are identical and facing each other. What differentiates the two use cases is that door 1.1 is “facing” the sun, whereas door 1.2 is not.

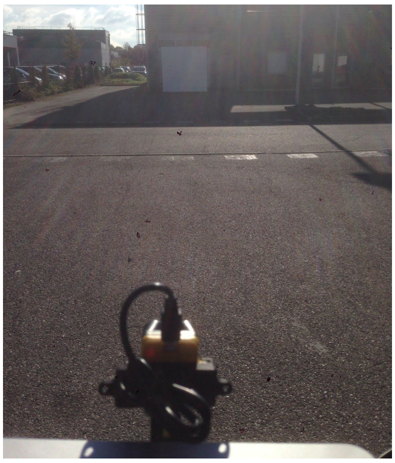
3.2 Target #2 grass bump

#	Illustration	Conditions description	Maximum range achieved
2.0		• Cloudy day • No direct sunlight exposure on the sensor or target, but sunlight is still perceptible	**11 m**
2.1		• Sunny day, clear sky • Direct sunlight on the target • Direct sunlight on the sensor • Potential sunlight reflections from the asphalt on the sensor	**5m**

3.3 Target #3 wood wall

#	Illustration	Conditions description	Maximum range achieved
3.0		• Cloudy day • No direct sunlight exposure on the sensor or target, but sunlight is still perceptible	**18 m**
3.1		• Sunny day, clear sky • Direct sunlight on the target • Potential sunlight reflections from the asphalt on the target	**10m**

3.4 Target #4 Painted plasterboard

#	Illustration	Conditions description	Maximum range achieved
4.0		• Cloudy day • No direct sunlight exposure on the sensor or target, but sunlight is still perceptible	**34 m**
4.1		• Sunny day, clear sky • No direct sunlight on the sensor • No direct sunlight on the target	**40m**
4.2		• Sunny day, clear sky • Direct sunlight on the sensor • Target is in shadow and no direct reflection of the sun from the asphalt to the target (sun is “behind the door”)	**30m**

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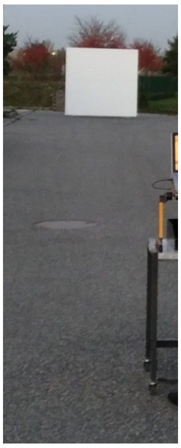
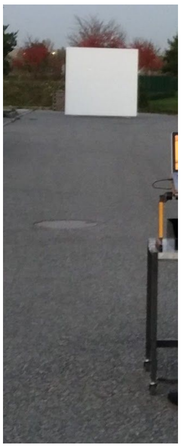
4.3		● Sunny day, clear sky ● Direct sunlight on the sensor ● Direct sunlight on the target ● Potential direct sunlight reflection on the target and the sensor	**20 m**
4.4		● End of the day (low light) ● No sunlight perceptible	**60m**

#	Illustration	Conditions description	Maximum range achieved
4.3		• Sunny day, clear sky • Direct sunlight on the sensor • Direct sunlight on the target • Potential direct sunlight reflection on the target and the sensor	**20 m**
4.4		• End of the day (low light) • No sunlight perceptible	**60m**

4 Conclusion

- TeraRanger Evo 60m sensor performance is not directly linked to light exposure per se but rather to the levels of near-infrared (NIR) light that is present in the ambient light conditions. Generally, NIR interference will rise with direct sunlight, but as the tests show, where that sunlight (NIR) is falling (on the target or on the sensor) is instrumental into the maximum range that can be obtained. Lots of sunlight on the target surface has more effect than sunlight on the sensor itself.
- The effect of NIR on the target surface explains why some of the test results may appear surprising. For example cases 4.0 and 4.2 give a similar maximum range even though the conditions appear far more favorable in case 4.0.
- The relative reflectivity or light absorbancy of the target surface will influence sensor readings. Surfaces that absorb light will lower the maximum range of the sensor. As we see, grass produced the worst test results.
- The accuracy of the sensor will also decrease in challenging environmental conditions but remains acceptable.

The following diagram illustrates the relative impact of high NIR light on the target surface and its relationship to both maximum range and reading accuracy.