

Measurements Quality Request

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Résumé:

The accuracy of measurements has a great affect on systems evaluation and validation test of models. In order to make results reflect the real life coverage, measurements should reach certain accuracy.

This document lists the specifications of the measurements routes that would be used for validation or comparison study with WaveSight, that includes the acceptable positioning error which we find out that it should be less than 8m, the minimum number of measurements sample required to estimate the average power and the measurements length for each measurement point.

In particular we show the affect of measurements positioning error on the prediction results and present the other specification that should be followed to obtain acceptable and reliable measurements. For that, a test conducted to presents the error would occur in radio wave signal prediction if measurements position has certain amount of error.

Company Information

Address

Lausanne Wavecall SA
Science Park of the
Swiss Institute of Technology
PSE-B / EPFL
1015 Lausanne

Phone +41 21 693 84 05
Fax +41 21 693 84 06

Amsterdam Wavecall BV
NZ Voorburgwal 66/III
1012 SC Amsterdam / NL

Phone +31 20 320 8302
Fax +31 20 528 7363

Contact Dr. Karim Rizk, CEO

Email info@wavecall.com

Web <http://www.wavecall.com>

Document History

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1. Introduction

This documents list the main specification that WaveSight required so that the measurements data would be used to evaluate the performance of WaveSight has enough reliability and precision to reflect the reality on the ground.

A study has performed using a real measurement route in London city and we tried to see the affect of the measurements positioning on the prediction results, for that we produced 32 different cases where we created a different positioning error in each case for two different calculation resolution.

Next chapter present the detailed study and the results obtained from moving the original measurements position, chapter 3 sets all specification required to obtain a reliable and acceptable measurement.

2. The affect of the position error on the precision of measurements

In this chapter we study the importance of having the measurements in a right position. For this aim we compare the results of the difference between the prediction on a large set of mobile location and the prediction found when mobile position are modified of 2, 4, 8 and 16 m.

This test was done on 5500 measurements point over London city (Figure 2). Because the mobile positions of the test route are not uniformly spread around the base station we moved the measurements point from its original positions of 2, 4, 8 and 16 m, in four directions (-x, +x, -y, +y). We took two different calculations resolution (5 and 2.5m). That gives 32 different results from the original position. Summarized in Table1.

Location offset from the original	5m resolution		2.5m resolution	
	Mean error dBm	Standard Deviation dBm	Mean error dBm	Standard Deviation dBm
-2X	0.11	0.58	0.13	0.48
+2X	-0.12	0.64	-0.13	0.46
-2Y	-0.02	0.72	-0.02	0.50
+2Y	-0.05	0.72	-0.01	0.58
-4X	0.29	0.97	0.32	0.91
+4X	-0.25	0.97	-0.16	0.97
-4Y	-0.07	1.22	-0.06	0.96
+4Y	-0.07	1.21	0.02	1.14
-8X	0.50	1.94	0.71	2.64
+8X	-0.27	2.25	-0.08	2.15
-8Y	-0.32	2.37	-0.26	2.40
+8Y	-0.20	2.43	-0.12	2.66
-16X	0.02	4.19	0.33	4.13
+16X	-0.35	3.95	0.05	3.93
-16Y	-0.67	4.86	-0.30	4.78
+16Y	-0.54	4.67	-0.60	4.63

Table 1 the affect of the measurements position on WaveSight prediction precision for one route file in London.

This table shows that for the same error produced in the measurements position the direction of the error produced and the calculation resolution has no important affect over the results, for that we could summarize the previous table with Table 2 and Figure 1 that present the error with relation to the absolute error position:

Location offset from the original	Mean error	Standard Deviation
2m	-0.01	0.59
4m	0.00	1.04
8m	0.00	2.36
16m	-0.26	4.39

Table 2 Summary of table1



Figure 1 Prediction error generated by error on measurements positioning.

Results show that an important prediction error could occur for measurements position error is over 8 m. As it shown in table2, if the measurements position error are 16 m from the original position, the standard deviation become considerably high (4.39 dBm).

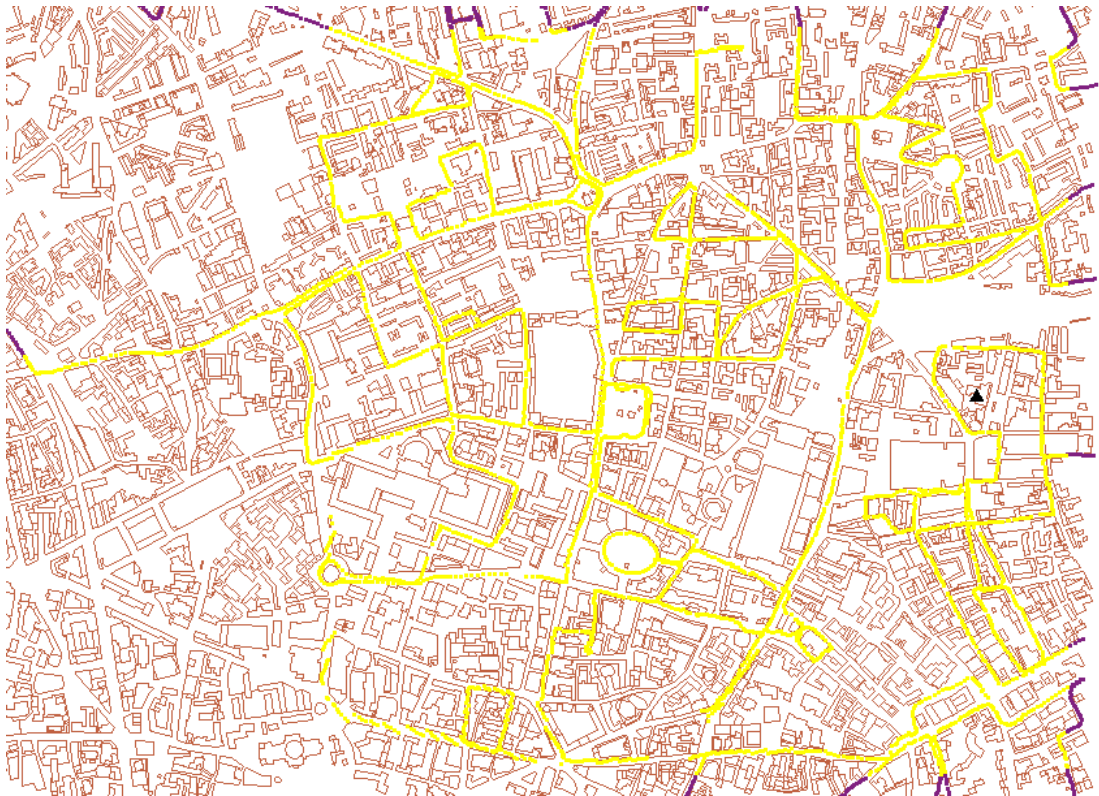


Figure 2 the measurements route in question shown in yellow, the black triangle is the base station location

3. Measurements quality specifications

To insure the efficiency of any validation test for WaveSight, where the validation done by comparing real measurements with WaveSight prediction the following rules should be followed in order to obtain reliable and valid results:

- Measurements points should not have an error of its position of more than 8m in standard deviation.
- The local average power of a mobile radio signal is obtained by smoothing out (averaging) the fast fading part, and retaining the slow fading part [1] by meeting the two following criteria:
 - The measured length of a mobile radio signal necessary to obtain the local average power should be 40λ [1], where $\lambda = c/f$, c is the velocity of light (300,000,000 m/sec) and f is the frequency: For example, if the frequency used is 2GHz the distance between two points is $(40 * 300000000 / 2000000000) = 6$ m.
 - The sufficient number of samples for estimating the local average power should be 36 measurements. It is based on a 90 percent confidence interval and less than 1dB error in estimate [1].

4. BIBLIOGRAPHY

[1] William C.Y. Lee: "Estimate of Local average Power of a Mobile Radio Signal", REF: 1985 IEEE