wavecall
See your net-work

wavesight™

Ray tracing model

<1.1>

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Résumé:

This is Paragraph 3 of our user manual; it should be updated for all our manual release after any modification of this part.

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Document History

Version	Revision	Date
1.0	O. Ghawi	June, 25 2001
1.1	O. Ghawi	August 14, 2001

Acknowledgements

Contents

1. WaveSight ray tracing model

1.1 Background

WaveSight is the result of more than eight years of research and development. The foundations of WaveSight are inspired from a five years Ph.D. thesis fully sponsored by well-established industrials in the domain of telecommunication such as Swisscom, KPN and Lucent technology. A strong team of renowned researchers continue working on extending the range of applicability of the model and increasing its performance. Wavecall research team has published more than 50 technical papers in the domain of propagation and can be considered as a world leading think tank in radio wave propagation.

1.2 WaveSight feature overview

WaveSight uses a combination of deterministic ray tracing in the vertical plane and the horizontal plane. Based on the uniform theory of diffraction (UTD) and ray-tracing, its algorithms take individual building foot prints and heights, as well as the terrain profile into account and accurately predict the signal power at every point of the area covered.

Its innovative implementation permits for unprecedented computing efficiency. The algorithm enables the simulation of a micro cell with a computation time of around 1 minute and a macro cell with a computation time around 5 minutes on a Pentium II 300 MHz machine. Speed and accuracy are thus no longer contradictory.

Because the method is fully deterministic, there is no need for calibration or measurement on the field. The domains of application include Wireless mobile, UMTS, Wireless Internet and fixed Wireless

It applies to urban areas for any transmitter and receiver heights.

1.3 Accuracy

As it is impossible to obtain a sufficiently detailed description of the propagation environment to solve the electromagnetic problem in a rigorous manner, i. e. solve Maxwell's equations, some assumptions had to be made in WaveSight to compute the propagation path loss. Even if the detailed description were available, the computation time needed to obtain a rigorous solution would be a limiting obstacle. In the absence of such a rigorous solution, the only way to test the validity of the WaveSight model is the comparison with measurements.

Therefore validations against measurement are a fundamental component of the model. Wavecall performed a large number of validations of WaveSight against measurements. The validations included comparisons over 1000 km of measurement routes in 100 cells located in a dozen of European and American cities. These comparisons showed that the WaveSight model achieves increased prediction accuracy in comparison with the classical models, typically delivering ±2 dB mean error and 7 dB standard deviation in comparison with measurements.

1.4 Computing time

WaveSight uses one of the most comprehensive methods to compute the propagation, that is ray tracing. This method is well known not only for its superior accuracy but also for being computing time demanding. The ray tracing implementation in WaveSight are innovative and original. They make use of numerous geometrical and electromagnetic tricks to minimize the computing time. Figure 14 shows an example of the calculation time with relation to the area of study. Note that the calculation time for the area of 8X8km, with a resolution of 5m is very high. This is because the machine RAM is low, in this case WaveSight is swapping, i.e. using the hard disk as memory, which make the computation time very slow.

It is highly recommended to use 512 Mbytes of RAM when the studied area is more than 4x4 km.

Test for the calculation time of WaveSight version 2.2.17

Machine: Pentium III, 650 MHz

RAM: 196 MB

City: Torino

Antenna: Isotropic

Frequency 1890 Mhz

Receiver Height: 1.5m

Area of study	1x1 km	2x2 km	4x4 km	8x8 km
Resolution	Calculation time	Calculation time	Calculation time	Calculation time
5	1 min 12 s	4 min 57 s	16 min 15 s	104 min 15 s
10	1 min 4 s	4 min 21 s	13 min 50 s	24 min 49 s
20	1 min 2 s	4 min 14 s	13 min 10 s	21 min 20 s

Figure 14 WaveSight computing time with relation to the area of study.