A COMPARISON OF ISO 9613-2 AND ADVANCED CALCULATION METHODS: PREDICTIONS VERSUS EXPERIMENTAL RESULTS

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1 INTRODUCTION

Standardization provides methodologies by which independent investigations of the same situation are able to derive the same conclusions. However, standardization is sometimes also perceived as absolute and accurate, beyond which one should not investigate matters deeper. Moreover, often enough the engineering community tends to neglect the science (or lack of it) underlying standardized methods and just follows prescriptions. Standardization provides algorithms that can be turned into software code. Software developers are always looking for ready-made algorithms with great market potential. The responsibility of the accuracy of these methods does not lie with the developers but with the standards organizations. This is not the case with algorithms based on pure scientific research where the full responsibility lies with those who turn it into software applications. Faced with a choice between prescribed methods of standardization with simple mathematical code vs. accurate scientific findings, PEMARD applied the latter developing complicated mathematical computation, albeit slower, yet delivering more accurate results in its commercially available software application[1].

2 COMMERCIALLY AVAILABLE THEORETICALLY BASED SOFTWARE APPLICATION THEORETICAL BACKGROUND

The Simulation and prediction of outdoor sound propagation using advanced calculation methods are based on principles of physics with an effort to try to avoid empirical or approximate methods, often found in published outdoor propagation standards.

The commercially available software application, utilizes sound ray modeling which solves Helmholtz's sound wave equation, accounting for sound diffraction to any order, sound wave reflection from finite size surfaces of finite impedance using Fresnel Zones and spherical wave reflection coefficient concepts, respectively. The approach uses flow resistivity instead of sound absorption coefficient. It also takes into account geometrical spreading, atmospheric absorption, and atmospheric turbulence. The software application also has an in-house developed algorithm to detect valid diffraction and reflection sound paths from source to receiver in a proper 3D environment. It is based on the image source method and the Geometrical Theory of Diffraction according to Keller[2].

3 ISO 9613-2[3] BACKGROUND

This standard is an empirical standard[4], which at the time of its preparation and publication, only few dedicated acoustical software applications existed for which most of the potential users of such software were "computer-phobic" since program user interface was not as convenient as it is today. It can therefore be said that there were good grounds to apply simpler empirical methods at the time.

There are however, many limitations in this method. The standard is vague, allowing the user to interpret the methodology according to their understanding, thus the user decides on whether vertical diffraction paths are important or not, as well as other significant parameters affecting final outcome.

4 PRESENTATION OF COMPARISON OF RESULTS AMONG COMMERCIALLY AVAILABLE SOFTWARE APPLICATION, ISO 9613-2 AND PUBLISHED MEASURED DATA.

4.1 Published measured data used as comparison reference

Two cases are presented based on sound measurements taken and presented in the Delta Report of 2006, "Nord2000: Validation of the Propagation Model for The Danish Road Directorate"[5].

Distance S - R		
	Thick barrier	Multiple barrier
4.5 m	Case 33	Case 36

Table 1: Cases used for the validation of NORD 2000 and implemented with ISO 9613-2 and the commercially available software application.

4.2 Comparison results

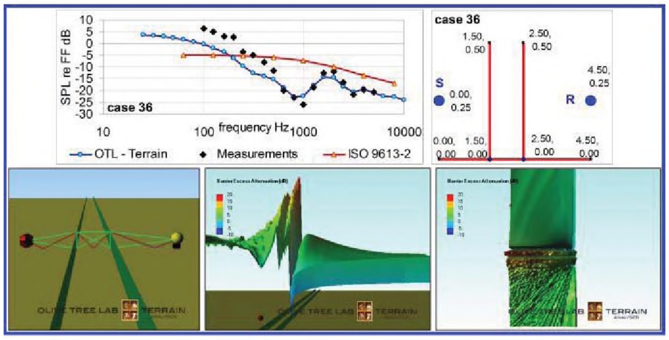

Figure.1. Results for Case 33.

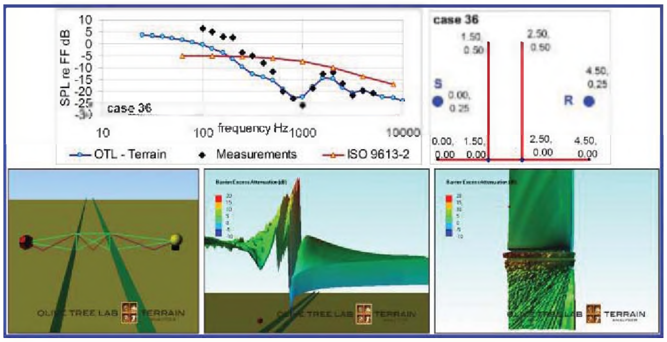

Figure.2. Results for Case 36.

4.3 Measurements Data

Measurement data used were the sound measurements results used to validate the Nord 2000 model. However, there is very little information available on the measurement methodology used. Some of the cases were able to be tracked down, which are not included in this paper (but are included in the report by Delta) and are described by K.B. Rasmussen in his work "On the effect of terrain profile on sound propagation outdoors."[6]

4.4 ISO 9613-2 results

Other than the obvious deviations of ISO 9613-2 calculation results from sound measurements results, ISO calculations lacks detail depriving the interpretation of the outdoor sound propagation mechanisms which come into play. On the other hand high-resolution results, allow for the interpretation of the sound propagation mechanisms that take place over ground and obstacles.

4.5 Theoretical Approach- e.g. Commercially available software application results

Even though the results from the software application matched fairly well with the results from measured data, they were expected to have a better agreement. This is because the software application was validated against other measured data[7], which as previously mentioned, there is limited information on the details of how the validation data were obtained. Furthermore, slight lateral shifts of source or receiver with respect to the barrier produce significant changes in results.

Another factor usually ignored in measurements studying sound interference phenomena, is the diffraction effects from loudspeaker cabinet units which contaminates sound measurements results by effectively turning one sound source into many sources.

5 CONCLUSIONS

ISO 9613-2 is an empirical method which is simple to understand and implement, widely used ever since its publication in 1996. It has served the acoustical community well, but this paper shows that it yields results that are inaccurate and imprecise.

Advanced calculation methods provide a unified approach in acoustics with one calculations engine to deal with most topics in acoustics. They offer the ability to simulate complicated environments by using simple rules and they apply accurate general solutions without vagueness to all scenarios, including special cases. Perhaps new scientific methods can now be used that allow the study of outdoor sound propagation mechanisms. The software application simulates sound propagation in a three dimensional environment with a possibility of eventually including all phenomena deemed important in acoustics.

The main disadvantage of advanced calculation methods is that they are still computationally expensive, and a better understanding of the science behind them is needed by end users for the proper interpretation of the results.

6 REFERENCES

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