QUALITY ASSURED SOFTWARE IMPLEMENTATION OF ISO 9613-2 ACCORDING TO ISO/TR 71534-3

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1 Introduction

The ISO 9613-2 standard is a well-known method for the calculation of industrial environmental noise. The standard was published in 1996 and since then has been implemented in numerous commercial software applications. The standard however, does not contain quality requirements for applications, such as test cases and recommendations for implementation. Therefore, the calculated results of different software implementations for the exact same situation cannot be expected to be the same. When comparing different software implementations of ISO 9613-2 the results can differ up to 5dB for simple situations and up to 10dB for complex situations. This makes the result of noise prediction even more uncertain. Not because of bugs or errors in the software, but because of unclear text and ambiguous algorithms in the standard. For many years this has been an inconvenient truth in the world of noise prediction. At the Forum Acusticum congress in 2005, special focus was put on uncertainties while implementing noise prediction standards. More papers on quality requirements for software implementation were presented in the years following. This has all contributed to the new quality standard ISO 17534 in 2015. In TR3 (ISO/TR 17534-3) test cases and recommendations for implementation of ISO 9613-2 are described in detail. This should make ISO 9613-2 unambiguous and makes it straight forward to implement in software. But to what extend is this true, and will this approach work for other calculation standards such as CNOSSOS-EU?

This paper describes the experiences of DGMR, member of the ISO 17534 working group, while using the recommendations of TR3 for a fresh and new software implementation of ISO 9613-2. Based on the experiences, this paper makes recommendations for quality requirements of existing and future standards.

2 What to expect from ISO/TR 17534-3

The main goal of ISO 17534 is to minimalize the differences in calculated results of different implementations of noise prediction standards. To examine the effect of ISO 17534, 2 commercial software implementations were compared using the 19 test cases described in TR3. Both software packages have options to include or exclude the recommendations of TR3.

The comparison could therefore be made for 2 cases; with and without the recommendations of TR3. The results of the comparisons are shown in table 1.

Table 1: Absolute differences in dB for 2 software packages with and without recommendations of IS0 17534.

Test case	With	Without
1-10	0.0	<=0.2
11	0.0	3.9
12	0.0	1.8
13	0.1	2.4
14	0.0	0.3
15	0.1	3.8
16	0.0	0.9
17	0.0	15.6
18	0.0	2.6
19	2.4	0.1

As displayed in Table 1 there is a significant positive effect when applying TR3. The large difference of 15.6 dB in test case 17 is now reduced to 0.0 dB. The reason for this is the new unambiguous rubber band method to calculate lateral detours. In ISO 9613 the left and right detours are in many cases unclear and ambiguous. One could choose to select the highest screening effect per individual screen or select the largest left and right detour. In TR3 the rubber band method is always used as shown in Figure 1.

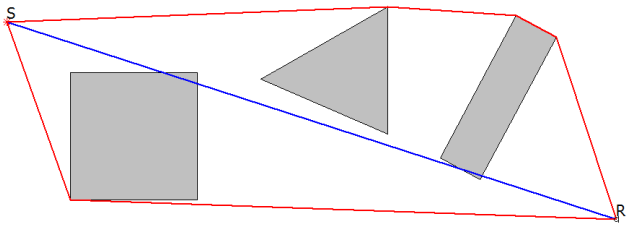

Figure 1: The red lines show the lateral detours using the rubber band method for test case 17

The exception of 2.4 dB for test case 19 is caused by a contradiction between TR3 and ISO 9613-2. According to TR3, in test case 19 there is a reflection contribution for 500 Hz until 8000 Hz octave bands. However according to ISO 9613-2 this reflection should only occur for the 8000 Hz octave band due to the low height of the reflecting facade in respect to the wave length. For 1 of the 2 software packages used in this comparison, the option to include the recommendations of TR3, obviously also de-activated the

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wave length criterion for the height of reflecting barriers. This omission has already been reported to, and acknowledged by, the ISO 17534 working group.

3 ISO/TR 17534-3, points for improvement

3.1 Nominal frequencies

In Chapter 1 of ISO 9613-2 it is stated that the calculations are executed with nominal mid band frequencies from 63 Hz to 8 kHz for the octave bands. However, in all test cases the calculations are performed for 62.5 Hz and not the nominal frequency of 63 Hz.

3.2 Speed of sound

In ISO 9613-2 the speed of sound is not given but only a note on how the calculation of the wavelength for the reflection criterion is calculated in which 340 m/s is used. The speed of sound however depends on the air temperature. One could use the same temperature which is used to select/calculate the air absorption.

3.3 Subdivision of line and area sources

Chapter 4 of TR3 states that line sources (including road and rail) are divided into line segments, area sources are divided into area segments, each represented by a point source at its centre. There are no rules given on how to do so. This indicates that the check "with automatic subdivision of line and/or area sources under consideration of the distance to the receiver" in Table 71 should be re-moved as it is not based on ISO 9613-2, unless it were added as an additional recommendation. There are only rules described for grouping point sources (same Lw and height, same propagation and d<2Hmax). This check is not included in table 71.

3.4 Wavelength criteria for screening obstacles

ISO 9613-2 states in Chapter 7.4 that an object is only considered to be a screening obstacle when its horizontal dimensions perpendicular to the source-receiver line is larger than the wave-length. It is not specified in TR3 if this requirement is used. Test calculations seem to indicate it is not used. In case of reflections this can quickly result in high barrier effect for only a small object, as (according to the recommendations) in reflection calculations only the vertical detour is taken into account.

3.5 Negative detour

The use of the rubber band method seems to indicate that no barrier effect will be calculated in case of a negative detour (the top barrier is below the direct line source – receiver). This is not ac-cording to ISO 9613-2.

3.6 Test cases T08, T09 and T19

In test case T08 the left and right detours are calculated. According to the factor 8 criteria of TR3 these should be omitted. In test case T09 the right detour is calculated. According to the factor 8 criteria TR3 this should be omitted.

In test case T19 a reflection is calculated in a barrier which is located on a slope and which length is larger than its height. It is only possible to replicate the results stated in TR3 when altering the model or calculation as follows:
1) The test case does not use the correct definition of lmin in formula 19. According to ISO 9613-2 the definition of lmin is "the minimum dimension (length or height) of the reflecting sur-face." In this test case the value lmin is determined by the height of the barrier and not by the length, thus, reflections are only possible for 8000 Hz.
2) If this height criterion is ignored and only the length criterion is used, the test case still does not give correct results as no reflection is calculated for 250 Hz. This seems to be the result of add-ing a node to the barrier where it crosses the height line at the bottom of the slope and thus shorten-ing the length of the barrier.

4 Conclusion

The ISO 71534 standard fulfils its aim. The differences in results between separate software applications for the same situation are strongly reduced. A similar positive affect can be expected when using this approach for CNOSSOS-EU. The ISO/TR 17534-3 report does contain some obvious errors, conflicts with ISO 9613-2 and unclear text. These could easily be fixed in a new revision. ISO/TR 17534-3 is more than a recommendation on how to interpret ISO 9613. It could be consider as a new method. So there are now 2 methods: ISO 9613 and ISO/TR 17534-3. This might lead to confusion

5 Recommendations

Replace ISO/TR 17534-3 by a review of ISO 9613 that includes the recommendations and test cases of ISO/TR 71534-3. This will make ISO/TR 71534-3 obsolete. Fix the issues as discussed in paragraph 3. Make clear choices. For instance state that the method is not suited for area sources and line sources or, add a clear unambiguous algorithm on how to do so. This recommendation also applies to any other existing or future standard.

References

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