Laboratory 1 – Smartphone calibration

Location

The laboratory exercise is carried out in the Acoustic lab of the V-building (LTH), entrance G2. The first part (1 hour approximately) involves the participation of all students at the same time (time and date to be determined). In a second step, the students will be divided in groups of 2-3 people to carry out the rest of the lab. To do so, time slots of one hour will be chosen for each group amid the proposed ones by the teachers.

Objective and preparation

The first lab session of this course deals with the analysis of the feasibility for the use of a smartphone as a sound level meter together with its calibration procedure. The questions that we aim to answer are the following:

1. Is it viable to use a smartphone as a sound level meter?
2. How is the calibration procedure designed and carried out?
3. What sound pressure levels have you recorded?
4. How accurate are your measurements?
5. What sources of error are there?
6. How can you estimate them?

Groups of 2-3 students will be formed, in a way that at least one member of the group has a smartphone that can record audio or voice memo. The lab will be divided into four parts described below.

Part 1. Measurement of sound - together

A single tone and a noise signal will be played one at the time by the teacher and all participants will record the same sounds together at the exact same spot. At the same time, the teacher will also record those sounds with a calibrated sound level meter, the latter ("real") results not being given to the students (yet).

Part 2. Calibration of measurement device

In order to perform the calibration, each group will have access to a function generator, an amplifier, a loudspeaker, a sound level meter and a computer. The measurement protocol, or rather, the calibration process, should be designed by yourselves (slightly helped by the teacher) justifying the steps undertaken (hint: one should find a way to establish a relationship between the raw data acquired by the smartphone's recorder –imported to a computer with a Matlab script provided by the teachers through the course website- and the values given by the sound level meter).

Questions of reliability and validity of the measurement should be addressed at this stage. Is it better to use discrete frequencies (i.e. a tone) or a noisy signal to calibrate? If a tone is used, how many different ones should one consider? Is one enough? What about the amplitudes (i.e. volume of the signal)? Should one consider several for each frequency? If a smartphone application that can register sound pressure level is also employed, you should ask yourselves if the value you receive is accurate and how accurate.

Part 3. Measurement of silence

In the final stage, "silent" will be recorded at a quite quiet location. When analysing the audio file, it will be noticed that there nevertheless is noise in the signal. Where does this noise come from? How does this fact affect your other measurements?

Part 4. What was the sound pressure level of the sounds recorded in "Part 1"?

Based on the calibration method designed in "Part 2" and the possible sources of errors estimated in "Part 3", translate the raw data acquired by your smartphone in "Part 1" into sound pressure level (in dB), and see if it coincides with the ones recorded by the sound level meter. Discuss the results.

Results

The results of the laboratory will be presented and discussed on Friday, November 13th at 13.15. Each group will shortly have to present the actual recorded values of sound pressure level from all measurements. Make sure that you have the following data at hand:

-The sound pressure level of the single tone
-The Z-weighted (un-weighed) sound pressure level of the noise
-The Z-weighted (un-weighed) sound pressure level of silence

Laboratory report

Generally, the results from a laboratory exercise are presented in a written report. In this first laboratory exercise, however, the oral presentation at the seminar will be the only presentation.

NB: There are some guidelines on how to write a technical report uploaded in the course website. One can start getting familiar with them for the next labs to come.