Comparison of Digital Sound Level Meter 1358 and Sen0232 Gravity Sound Level Meter

A small study by Team Ethernet

For II1305 Project in Information and Communication Technology

KTH Spring 2019

Abstract

In our current project we were given two sound level meters from our external product owner with a request to determine the differences between them so that a we could determine if the newest of the two was up to par with the old one.

The study concludes that the Sen0232 (newest microphone) is the preferred meter as it performs better than the 1358 (old microphone).

Testing and report by: Andreas Sjödin & Valter Lundegårdh

Introduction

In this study the Digital Sound Level Meter 1358 and the Sen0232 Gravity Sound Level meter are compared.

The reason for this study was to find out if the meters reacted differently to different frequencies if the dB level differed. This was done so that our project group could assure that the newer microphone is preferred over the old one. The comparison covers what value the meters output at different dB levels at different frequency levels.

Method

Equipment

- 1 Sennheiser Urbanite headphones
- 2 avr-rss2 MCU
- 1 Digital Sound Level Meter 1358
- 1 Sen0232 Gravity Sound Level Meter
- 1 Laptop
- 1 Quiet room

Software

- Cockos Reaper
- Contiki OS
- PuTTY
- Google Docs Spreadsheets

The two meters were connected via the 2 avr-rss2 MCUs to the laptop where PuTTY was configured to read the outputs from the COM ports and log the data to two separate text files. Reaper was configured to play a sine wave at configurable frequencies and dB levels, beginning at 100 Hz and at -40 dB (RMS). The laptop sound output was set to 50%. The meters diaphragms were placed at equal distance from the speaker elements in the headphones.

The test was started by resetting both MCUs so it would be clear in the log files where the test began. After the first measurement was read by the meters and sent to PuTTY and logged in the text files, the frequency was increased in steps of 100 up until 8.5 kHz.

The resulting text files with the logged data were imported into a spreadsheet.

The test continued by raising the volume to -30 dB, resetting the frequency back to 100 Hz, clearing the log files, restarting the MCUs, and redoing the method of raising the frequency after every measurement.

Hz/dB				
0	-40 (o)	-40 (n)	-30 (o)	-30 (n)
100	35	34	35	35
200	36	36	36	36
300	35	34	34	34
400	41	41	35	35
500	35	37	35	35
600	36	36	35	36
700	35	36	36	36
800	35	35	36	36
900	36	35	38	37
...	...	...	...	...
8400	35	36	36	38
8500	36	36	37	38

Fig 1. Part of the resulting table in the spreadsheet. The letter "o" was used for the Digital Sound Level Meter 1358 and the letter "n" was used for the Sen0232 Gravity Sound Level Meter.

The test was repeated for -40 dB, -30 dB, -20 dB, -10 dB, and 0 dB (RMS)

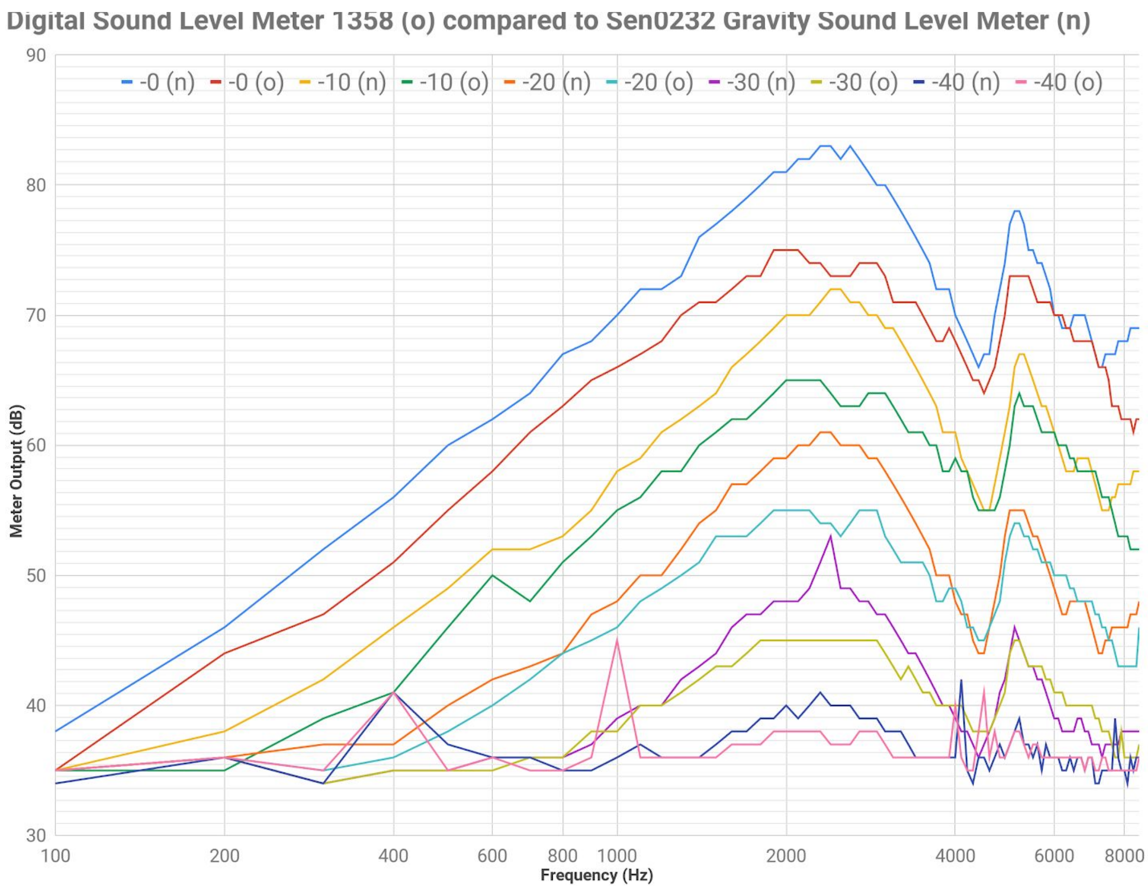

Fig 2. The resulting graph of the measured data from the meters at the specified dB levels from 100 Hz - 8500 Hz.

The different lines on the graph represent a series of readings from one of the microphones. For example -40 (*o*) shows the data from the Digital Sound Level Meter 1358 at -40 dB, -10 (*n*) shows the data from the Sen0232 Gravity Sound Level Meter at -10 dB.

The data values are the output values from the different meters. For example when playing the sine wave at 2 kHz at -20 dB the Sen0232 Gravity Sound Level Meter had an output of 59 dB.

Analysis

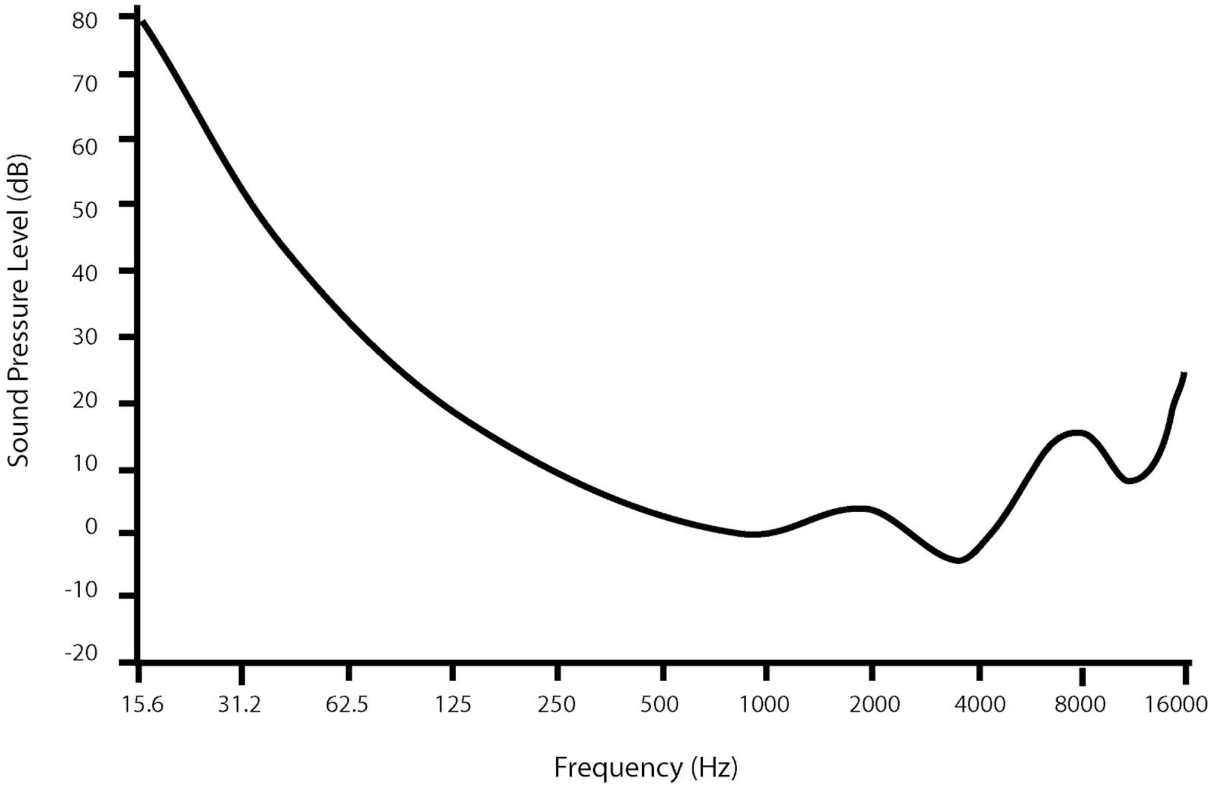

Fig 3. Equal-loudness contour graph (Perceived Human Hearing.svg, 2016)

Since both meters are configured for dBA, the data is expected to correspond to the equal-loudness contour curve.

The resulting graph shows that the Digital Sound Level Meter 1358 does not correctly pick up the expected increase in dB between 1.8 kHz - 3 kHz, and instead flattens out during this range. Another fault is visible at around 7.5 kHz and above, where the output is expected to go up but the output instead goes down. The Sen0232 Gravity Sound Level Meter does not have these characteristics and instead behaves as expected.

Mirroring the equal-loudness graph on the horizontal axis allows us to see its correspondence to the result graph. The result graph below is limited to only two data series to show this more clearly.

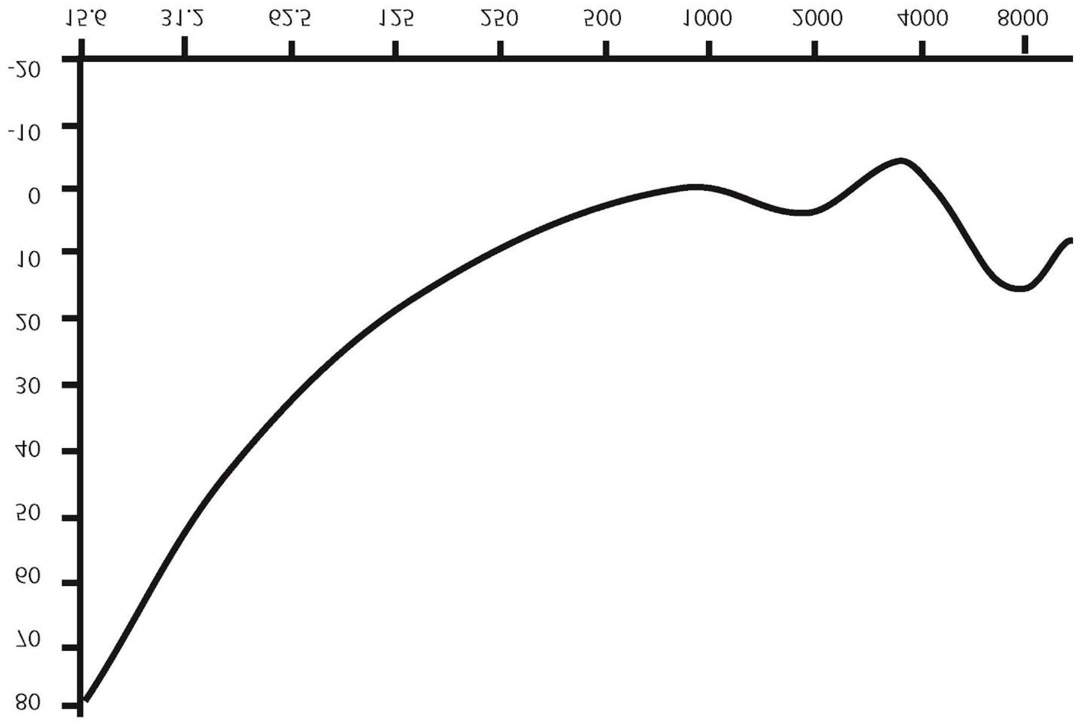

Fig 4. The equal-loudness graph mirrored around the x-axis.

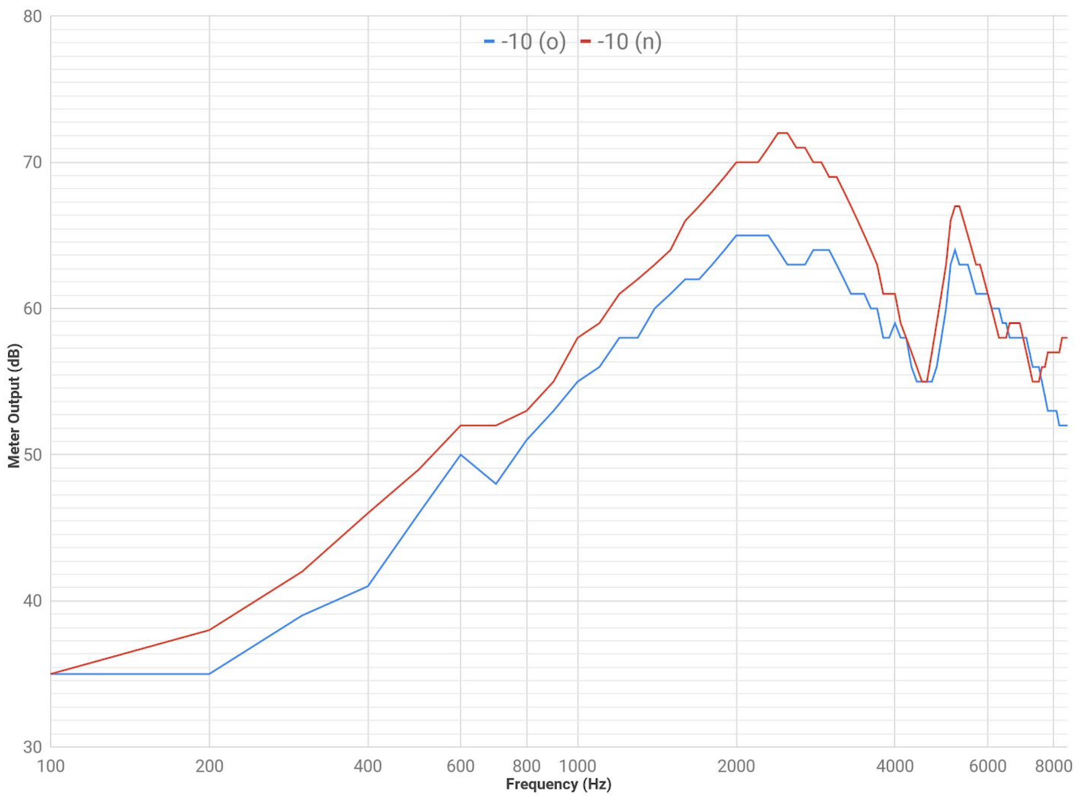

Fig 5. Measured data from the meters at -10 dB (RMS) from 100 Hz - 8500 Hz. The blue graph is the Digital Sound Level Meter 1358 and the red graph is the Sen0232 Gravity Sound Level Meter.

Conclusions

The results show that the Sen0232 Gravity Sound Level Meter is preferred for measuring sound levels when frequencies are in the 1.8 kHz - 3 kHz interval and 7.5 kHz and above are expected. Noise in these frequencies are generally always present in normal environments, so for the purposes of general sound-level measurement, the Sen0232 Gravity Sound Level Meter is preferred over the Digital Sound Level Meter 1358.

Error sources

1. The possibility that there was a difference in the two speaker elements was ruled out by switching which meter was listening to which element, the results were the same.

2. Some external noise was present sporadically in the room. Spikes in the data, such as the one at *1000 Hz -40 (o)*, have not been pruned. This can generally be disregarded though due to the large amount of data points in the series. However if this study is to be conducted in the future a soundproof room is recommended.

3. As the resolution of the readings are given as integers, some rounding errors may have occurred and may therefore have misrepresented the actual reading from the meter. This can also be disregarded for the same reason as error source 2.

4. Low resolution of measurements are achieved in the lower spectrum of the frequencies as the frequency was increased by 100 for every step in the test. This could have been rectified by increasing it by smaller increments in the lower parts of the spectrum (below 1 kHz) and increasing the size of the increments in the higher parts of the spectrum.

Word list

MCU = Microcomputer unit
RMS = Root mean square
dBA = A-weighted decibel

References

File:Perceived Human Hearing.svg. (2016, November 28). Wikimedia Commons, the free media repository. Retrieved 07:32, May 21, 2019 from https://commons.wikimedia.org/w/index.php?title=File:Perceived_Human_Hearing.svg&oldid=223352983.