OpeNoise: a nice software

A dear friend introduced us to the OpeNoise application. It allows you, via smartphones and the like, to make sound impact assessments in a clear and reliable manner.
We immediately liked the application. It's very readble and seems to do what we need. It is made-in-Italy, developed by / with ARPA Piemonte*, a satisfaction for us.

Our friend had warned us of some difficulty in calibration: an excellent opportunity to learn more about the application and demonstrate the need to use microphones with low sensitivity with Android systems in very noisy environments.

While iOS systems allow for some gain setting of the microphone amplifier (that follows the mini-jack or lightning adapter), Android systems seem to have a fixed gain of +20 dB. For this reason our microphones model CEL-4 for iOS smartphone and tablet have a sensibility of -40.0dB V/Pa or 10mV/Pa and the ones intended for Android devices of -60.0dB V/Pa or 1mV/Pa.

So we used OpeNoise on a cheap Android smartphone (80€ ca.) to compare the performance of two microphones of different sensitivity : -40.4dB V/Pa or 9.5mV/Pa the first one and -60.2dB V/Pa or 0.98mV/Pa the second one.

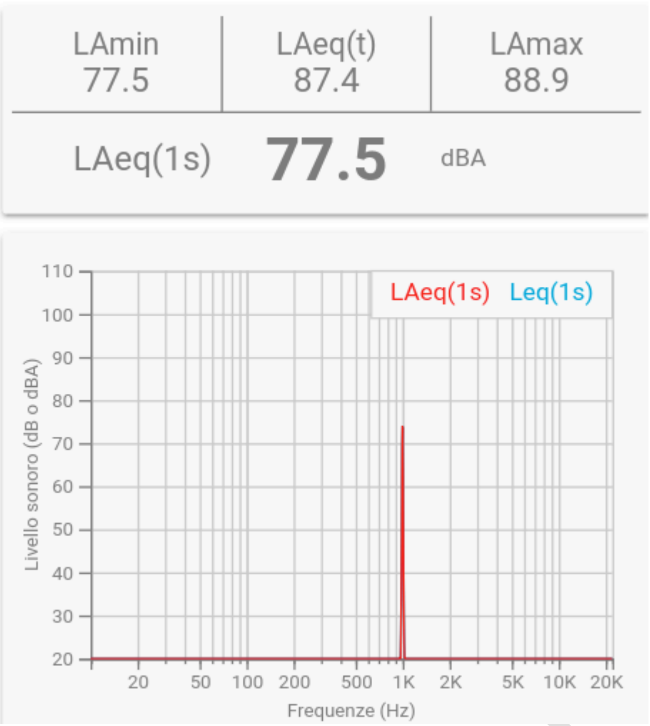
As enlighted by our friend, the permitted calibration range (offset) of +/- 30dB doesn't allow to correctly set the low sensitivity microphone, so, without any calibration, we exposed , sequentially, the two microphones to three sound pressure levels: 94/104/114 dB SPL @ 1 kHz, saving the screenshots produced by the software.

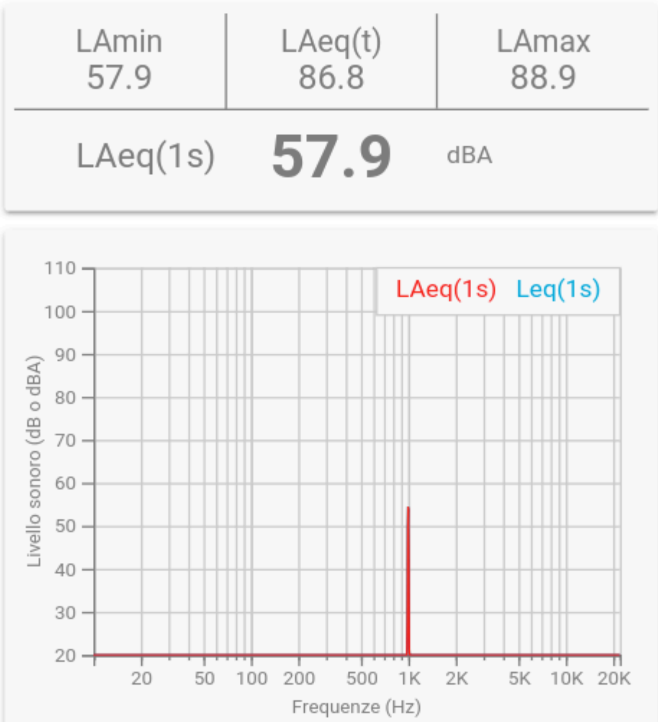
At the top of the screen, OpeNoise shows the A-weighted sound pressure levels (minimum, equivalent over time t and maximum). Immediately below, in the center, in bold and in plain sight, it shows the integrated sound pressure level A weighted for the time of 1s (the data that most often interests us).
Under these pressure indications, we find a graphical area that offers four options:
the history of sound pressure level;
the third-octave signal spectrum;
the sonogram;
the narrowband spectrum (FFT), A-weighted and flat.
Through this last choice we can observe the possible presence of harmonics and estimate the distortion produced by the system.
[The spectrum of an undistorted signal is a nice graph showing only one vertical line corresponding to the frequency of the acquired signal. When harmonic distortion should occur, we would see vertical lines corresponding to the harmonics of the fundamental, not present in the generated signal, whose amplitudes determine the magnitude of the total harmonic distortion (THD).]

In the left column we report the results obtained with high sensitivity microphone and in the right column those of the low sensitivity microphone.

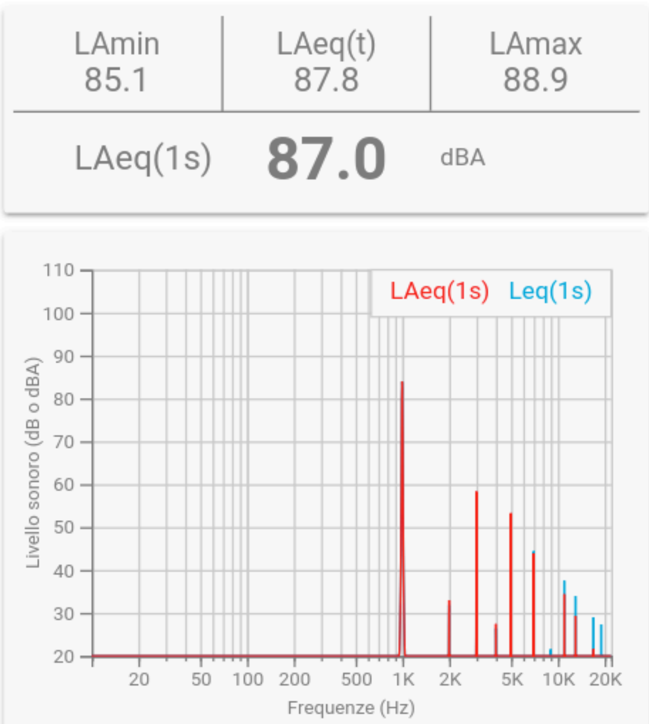
High Sensitivity Mic. Low Sensitivity Mic.

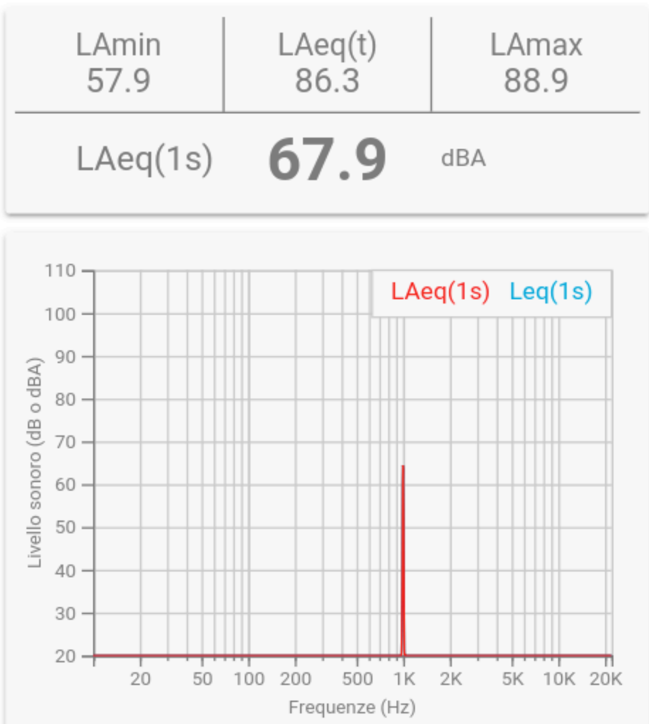
94 dB SPL



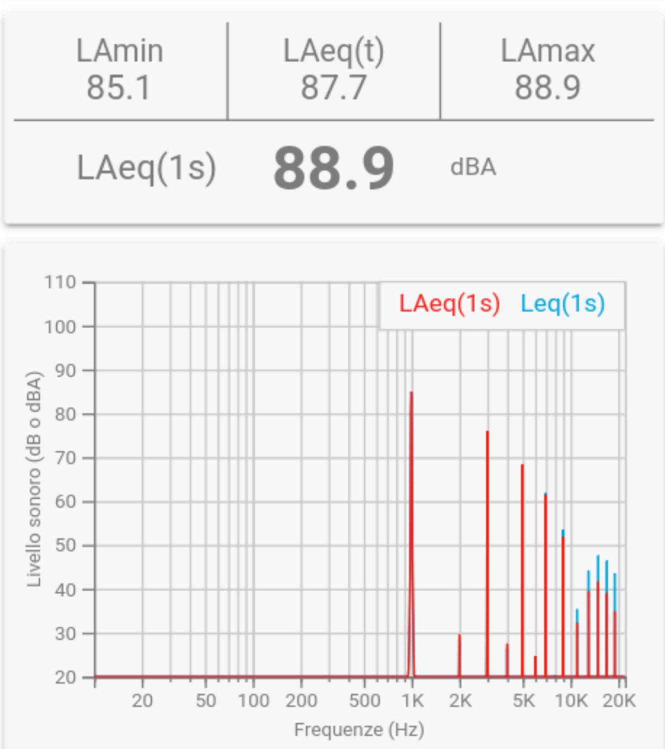


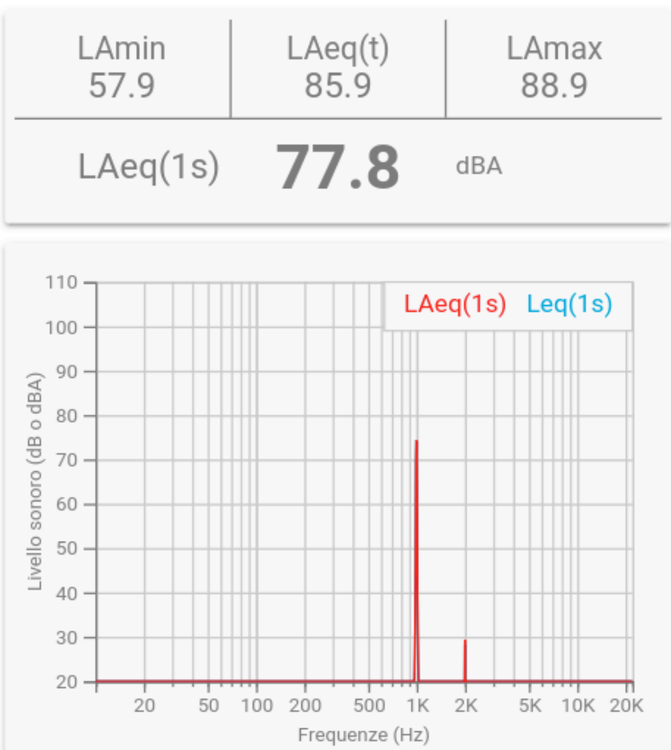
104 dB SPL





114 dB SPL





The spectral components of the various graphs are self-explanatory. The increasing distortion in the left-hand screens (high-sensitivity microphone) is always much greater than that observed in the system with a low-sensitivity microphone on the right. *[The harmonic distortion we see can not be attributed to microphones that have a distortion of less than 3% at 125 dBSPL and less than 1% at 115 dB.]*
The indication of the pressure level, although not calibrated, is a further confirmation:
At 104 dBSPL the left system already shows a "compression" of 0.5 dB (77.5 dBa at 94dB and 87dBa at 104dB). At 114 dB it is in full distortion. The one on the right instead shows just -0.1 dB deviation at 114 dBSPL (77.8dBa instead of 77.9). From the FFT we can deduce a distortion well below 1%, being the first harmonic at a level of about -50dB compared to the fundamental.

We really like this software. We contacted the Arpa Piemonte* and the developers to show them our little test and ask them to extend the calibration range so to be able to correctly employ even low sensitivity microphones.
Not only we had a very quick response, but they also assured us that the next release of OpeNoise will welcome our requests. Thanks!!!

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*ARPA Piemonte: It's a regional authority for enviroment protection. Piemonte is the italian district that hosts national metrology headquarters.