Accurate Ambient Noise Assessment Using Smartphones

DOCTORAL PROGRAM IN COMPUTER SCIENCES

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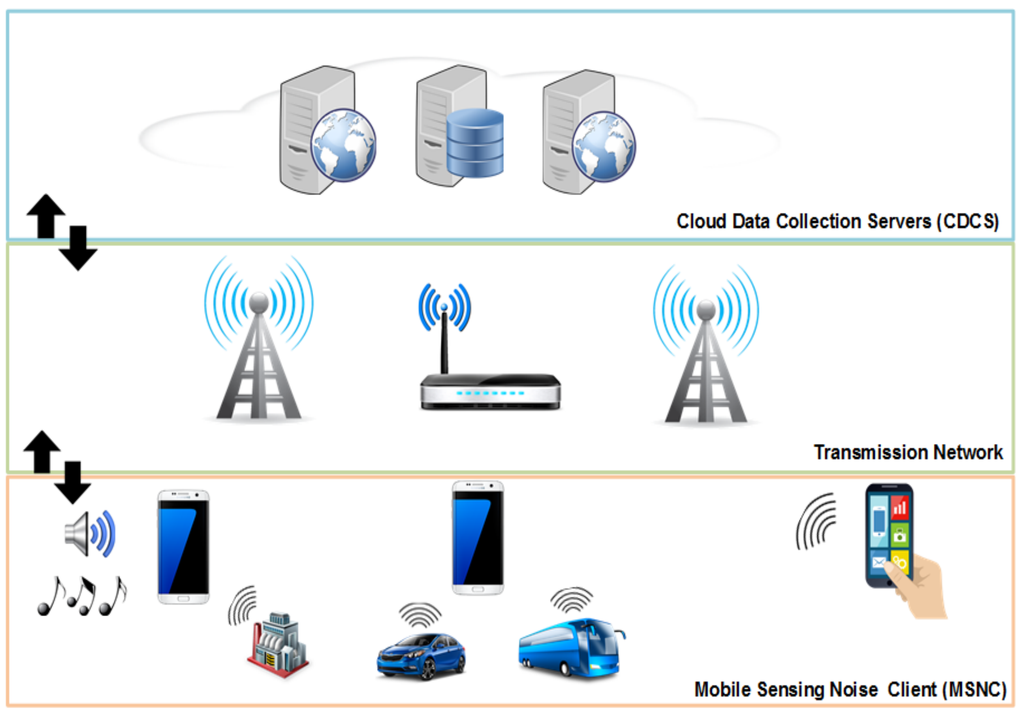
Background

- Mobile crowdsensing solutions for noise pollutions monitoring
- Sound Capture and processing procedure
- Different noise calculation algorithms



Proposed crowdsensing architecture for noise analysis

Objectives

- Propose an architecture for mobile crowsensing solutions
- Analyse the behavior of three different algorithms for noise measurement
- Evaluate the impact of different sampling rates and block sizes
- Evaluate the candidate algorithm using different types of smartphones in typical outdoor environments

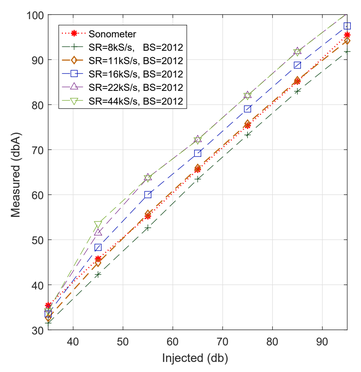
Method

ALGORITHM 1: dB(A) calculating using Fourier Transform.

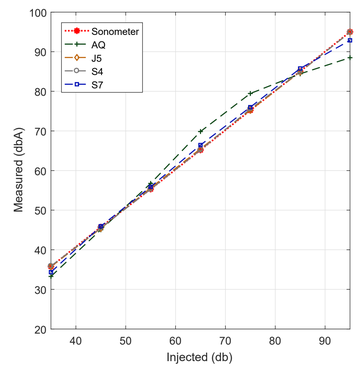
Data: BufferRawData, AudioRecord
Input: $SR(SampleRate); BS(BlockSize); T(Totaltime)$

$k = \frac{SR}{BS}$
for $c = 1$ *to* T **do**
  $dat = 0$
  for $z = 1$ *to* k **do**
    Read current AudioRecord with Block Size BS
    for $i = 0$ *to* BS **do**
      $w = \frac{1}{2}(1 - \cos(\frac{2\pi i}{BS-1}))$
      $sample(i) = NormalizedRawData(i) \cdot w$
    end
    FFT(Array $sample$)
    for $i = 0, j = 0; i < BS/2; i++, j+= 2$ **do**
      $mag(i) = \sqrt{FFT(j)^2 + FFT(j+1)^2}$
      $dat = dat + 10^{\frac{L_{pmag(i)}}{10}}$
    end
  end
  ToLogFile$(10 \cdot \log_{10} \frac{dat}{k})$
end

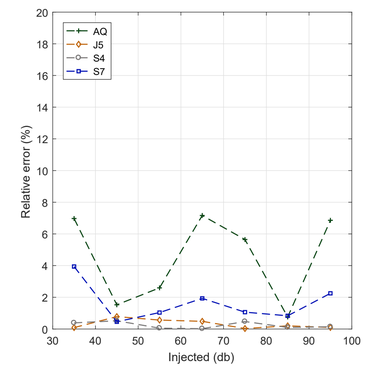
Results



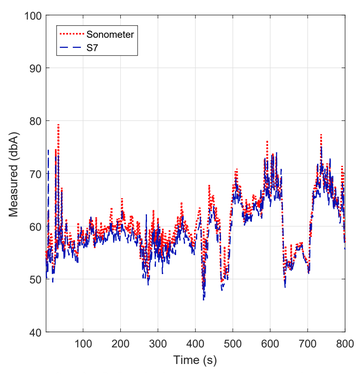
Sampling rate analysis when fixing the block size



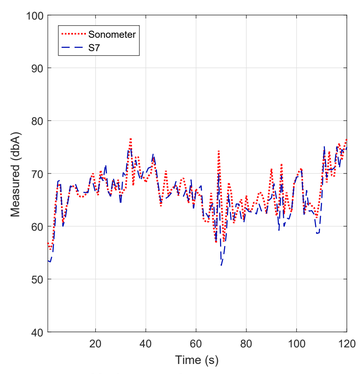
Adjusted using linear regression



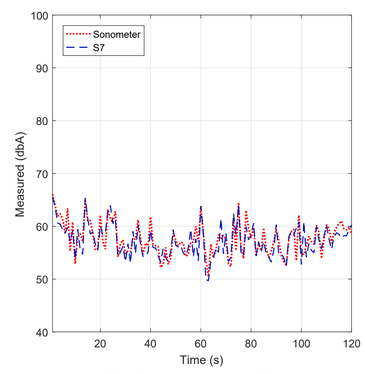
Estimation error



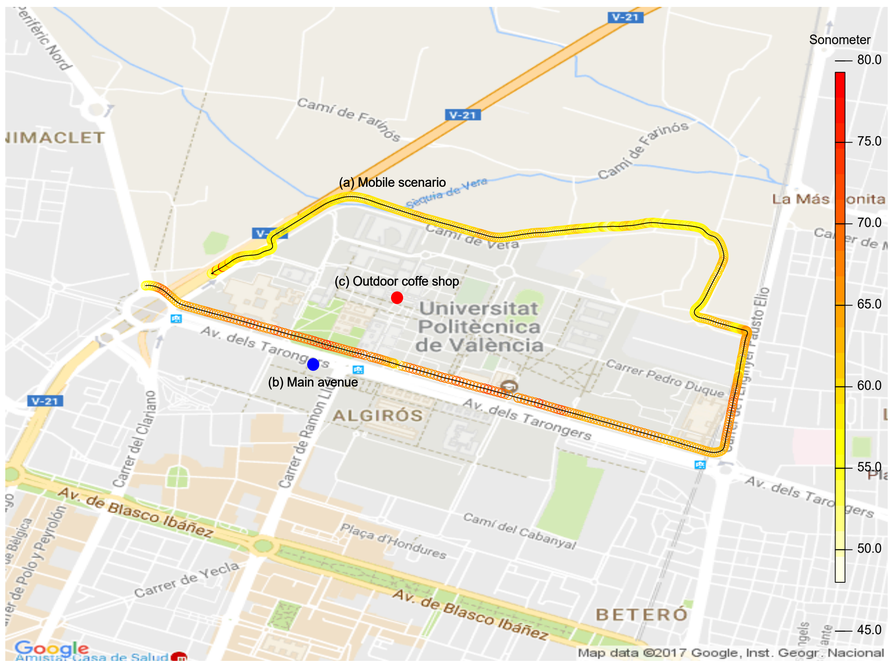
(a) Mobile scenario



(b) Main avenue



(c) Outdoor coffee shop



Mobile scenario results

Conclusions

- Result show that both the sampling rate and the selected buffer size can have a significant impact on the accuracy of noise level estimations (error : 1% to 12%)
- Through an adequate selection, it is posible to combine low noise-level errors with a low computational overhead.
- Low-end smartphones are prone to introduce a higher error than high-end smartphones (on average).
- As future work, we plan to integrate this algorithm in a crowsensing application to achieve distributed noise measurements.

Acknowledgement

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