Mobile Sensing: Spring 2015
Exercise: 7

Due on 27th April 2015 by 23:59 PM.

Instructions: All course participants are requested to submit their exercise solutions electronically to the instructors (samuli.hemminki at cs.helsinki.fi and teemu.pulkkinen at cs.helsinki.fi), as well as to the course lecturer (petteri.nurmi at cs.helsinki.fi) by the due date (latest before the exercise session). In all the exercises, do not just give the answer, but also the derivation how you obtained it. Participants are encouraged to write computer programs to derive solutions to some of the given problems.

Ex 1. Windowing

Consider the audio sample in gong.csv. Perform windowing on the signal (Hamming) (over the entire sample) and compare the results visually when considering

a) the FFT of the original signal

b) the FFT of the windowed signal.

What is the main difference?

Ex 2. Spectral entropy & Log-energy

This time, use the sample mtlb.csv (sampling frequency: 7418 Hz). Divide the sample into frames of 32 ms and calculate for each frame:

a) the spectral entropy

b) the log-energy.

Find voiced and unvoiced parts of the signal by choosing suitable thresholds for the parameters you calculated. Plot the voiced/unvoiced status of each frame alongside the original signal.

Ex 3. Colocation detection

a) Calculate time-frequency similarity of three audio signals A, B and C. Use correlation as distance metric for both time and frequency domains. Combine results using the formula given in the lecture slides: sim(i,j) = 1 - $\sqrt{d_{time}(i,j)^2 + d_{freq}(i,j)^2}$

b) The file fingerprints.csv contains 10 WiFi RSSI measurements (rows). In each measurement, 29 access points can be observed (columns). Use two signal based similarity measures to compare the signal pairs. Which of them have been recorded close to each other? You can assume the order of access points is the same for all measurements.

Ex 4. Cepstrum

Given the signal in mtlb.csv

1. Plot the fft of the signal
2. Construct the cepstrum of the signal and plot it.
3. Perform (high-time) liftering on the signal. Extract the spectral envelope of the signal and plot it.