

# Acoustical signal processing

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## ECTS

3

## Mots clés

Digital Audio

## Description du contenu de l'enseignement

### Objectives

Learning how to solve simple audio signal processing problems by means of signal models and dictionaries, sparse principles etc.

### Theoretical content

- Reminder on Fourier. Filtering and numerical filters synthesis
- Random signals, Power Spectrum Density (PSD), PSD estimators (periodogram, Welch), AR model
- Frequency estimation (Fourier, HR methods)
- Time-Frequency analysis/synthesis: Short Time Fourier Transform (STFT)/Gabor, bank filters interpretation (Wide/short band, speech analysis), uncertainty principle, non surjectivity of STFT, re-synthesis of the signal (Frames introduction), MDCT
- Non uniform bank filters, introduction to wavelets and non stationary Gabor frames
- Atomic decomposition: Matching Pursuit, Introduction to sparsity

### Practical content

- Introduction to audio Analysis/Synthesis
- • Denoising and compression of audio signal
- Audio signal restauration (declipping, decliccing)

## Compétences à acquérir

### Compétences principales

Being able to

- choose the right signal model: deterministic or random
- choose an appropriate dictionary (Gabor or wavelets) for a given signal and the application
- use the sparse principle for audio signal processing in order to solve simple audio signal processing problems

### Compétences complémentaires

Use of MATLAB and for programmation and signal processing

## Modalités d'organisation et de suivi

### Coordinateur

Matthieu Kowalski (Université Paris-Sud)

## **Équipe pédagogique**

Bertrand David (Télécom<sup>1</sup>-ParisTech)

## **Langue**

Anglais

## **Volume horaire**

CM : 15h, TP : 15h

## **Bibliographie, lectures recommandées**

A wavelet tour of signal processing (S. Mallat)

## **Pré-requis obligatoires**

Basics of signal processing (Fourier analysis, Z-transform, FIR and IIR filters, introduction to random signals)

## **Mode de contrôle des connaissances**

Exam (70%) + Practical work (30%)