



NATURAL BORN INTERACTIVE



Long Project with Audiogaming

Additive Synthesis with Inverse Fourier Transform for Non-Stationary Signals

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Stationary Signals

- hjh

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- ▶ Localization: Toulouse, Paris
- ▶ Activity: Audio plug-in (VSTs and RTAS)
- ▶ Main customers: Film and Video Game Industry (Sony, Ubisoft)
- ▶ 10 employees

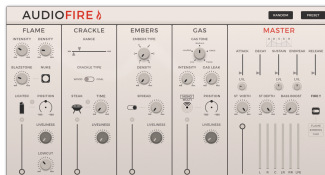


Figure: Audiofire: audio plug-in that recreates fire sound



- We are continuing the Audiogaming long project from 2015 (Emilie Abia, Lili Zheng, Quentin Biache)

Objective : Synthesizing sounds from their spectrum with a FFT^{-1}

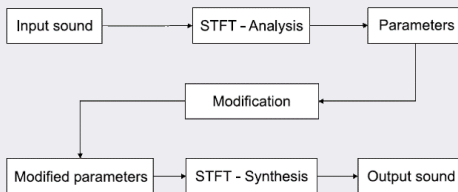


Figure: General approach for modifying a sound in the spectral domain

- We have to implement a new method of additive synthesis \Rightarrow computationally very fast



- ▶ 6 weeks only \Rightarrow Focus on the synthesis method only.

Given codes in Python and Matlab from the 2015 project :

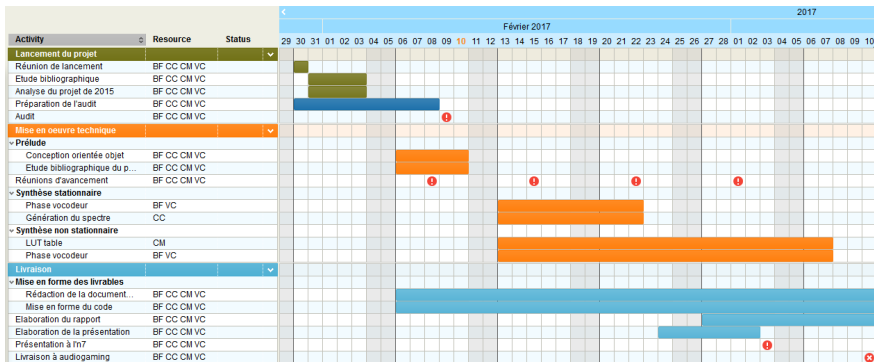
- ▶ Python : Analysis estimator of sinus parameters and sinus generation with those parameters (only stationary)
 - ▶ Matlab : Some reasearch on the Non-stationary synthesis with the LUT of lobes
-
- ▶ We made our own OOP codes in Python
 - ▶ We have taken the analysis estimator code to test our final synthesis



Figure: *PyCharm* as Python IDE , *Slack* to communicate, *GitHub* to stock the codes and have a versionning, *Freedcamp* to plan the project events

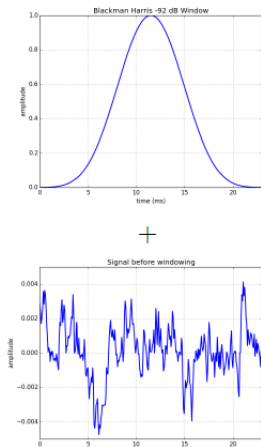
Introduction

Project Management : Gantt Chart



The analysis

Step1



Windowing step :

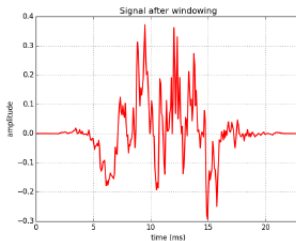


Figure: *Windowing step*

The analysis

Step2



Peak detection and extraction of parameters by STPT (particular Short Time Fourier Transform):

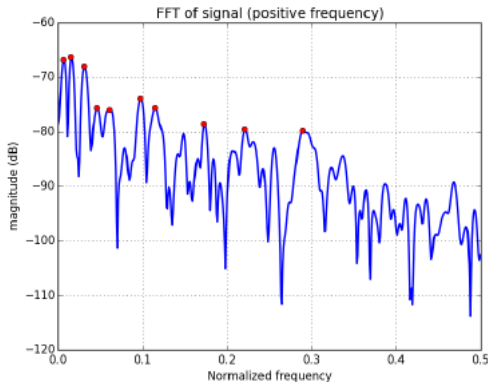


Figure: *Windowing step*

The additive synthesis

General approach: The time domain



The sound signal is represented as a sum of N sinusoids:

$$x(t) = \sum_{n=1}^N a_n \sin(2\pi f_n t + \phi_n)$$

- ▶ Very costly to implement
- ▶ Impossible to compute in real-time

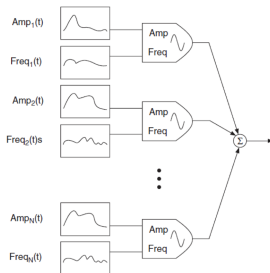


Figure: *The additive synthesis*

The additive synthesis

General approach: The frequency domain



We generate the sinusoids in frequency domain in order to reduce the computation time :

- ▶ Window the signal to maximize the energy in the main lobe
- ▶ We only keep the main lobe for each sine (9 points)
- ▶ We assume that the parameters (amplitude, frequency, phase) are already given by the analysis

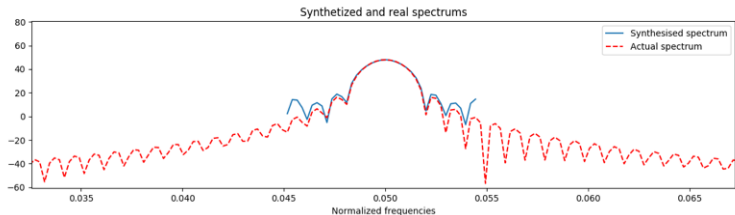


Figure: *Windowed sine lobe*

The additive synthesis

The frames



The sound signal is a frame-by-frame signal:

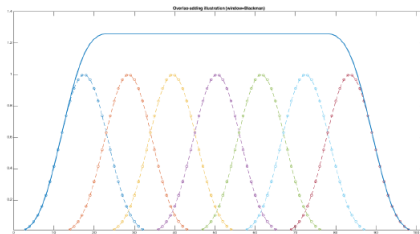


Figure: *Sum of small size Hanning windows*

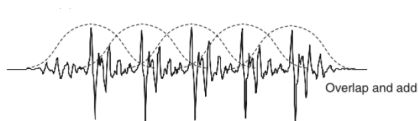


Figure: *Overlap and add*



The theme contains 4 source files:

- ▶ `beamercolorthemeFeather.sty`
- ▶ `beamerouterthemeFeather.sty`
- ▶ `beamerinnerthemeFeather.sty`
- ▶ `beamerthemeFeather.sty`



The theme can be installed for **local** or **global** use.

Local Installation

- ▶ Local installation is the simplest way of installing the theme.
- ▶ You need to placing the 4 source files in the same folder as your presentation. When you download the theme, the 4 theme files are located in the `local` folder.

Global Installation

- ▶ If you wish to make the theme globally available, you must put the files in your local latex directory tree. The location of the root of the local directory tree depends on your operating system and the latex distribution.
- ▶ Detailed steps on how to proceed installation under various operating systems can be found at Beamer documentation.



For using the Feather Theme you will need the Bemaer class installed and the following 2 packages

- ▶ TikZ¹
- ▶ calc

Due to the fact that the packages are very common they should be included in your latex distribution in the first place.

¹TikZ is a package for creating beautiful graphics. Have a look at these [online examples](#) or the [pgf user manual](#).



The Presentation Theme

The Feather Theme can be loaded in a familiar way. In the preamble of your `tex` file you must type

```
\usetheme[<options>]{Feather}
```

The presentation theme loads the inner, outer and color Feather theme files and passes the `<options>` on to these files.

The Inner and Outer Themes

If you wish you can load only the inner, or the outer theme directly by

```
\useinnertheme{Feather} (and it has no options)
```

```
\useoutertheme[<options>]{Feather} (it has one option)  
    progressstyle={fixedCircCnt or movingCircCnt}
```

- ▶ which set how the progress is illustrated;
- ▶ the value `movingCircCnt` is the default.



The Color Theme

Also you can load only the color theme by writing in the preamble of the `tex` file

- ▶ `\usecolortheme{Feather}`

...or to change the colors of the various elements in the theme

- ▶ Change the bar colors:
`\setbeamercolor {Feather}{fg=<color>, bg=<color>}`
- ▶ Change the color of the structural elements:
`\setbeamercolor{structure}{fg=<color>}`
- ▶ Change the frame title text color:
`\setbeamercolor{frametitle}{fg=<color>}`
- ▶ Change the normal text color background:
`\setbeamercolor{normal text}{fg=<color>, bg=<color>}`



The Feather Background Image

- ▶ In Feather theme, the title page frame and the last frame have the Feather image as the background image.
- ▶ The Feather background image can be produced to any frame by wrating on the begining at the choosen frame the following

```
{\1bg  
\begin{frame}[<options>]{Frame Title}{Frame Subtitle}  
...  
\end{frame}}
```

A decorative graphic on the right side of the slide, consisting of multiple overlapping, curved, feather-like or wave-like shapes in shades of light blue and white, with some small white dots scattered within the curves.

Thank you for using Feather Beamer Theme!