

Computational deconstruction of sounds for music composition and performance

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Colloquium, oct 20, 2023

CNMAT



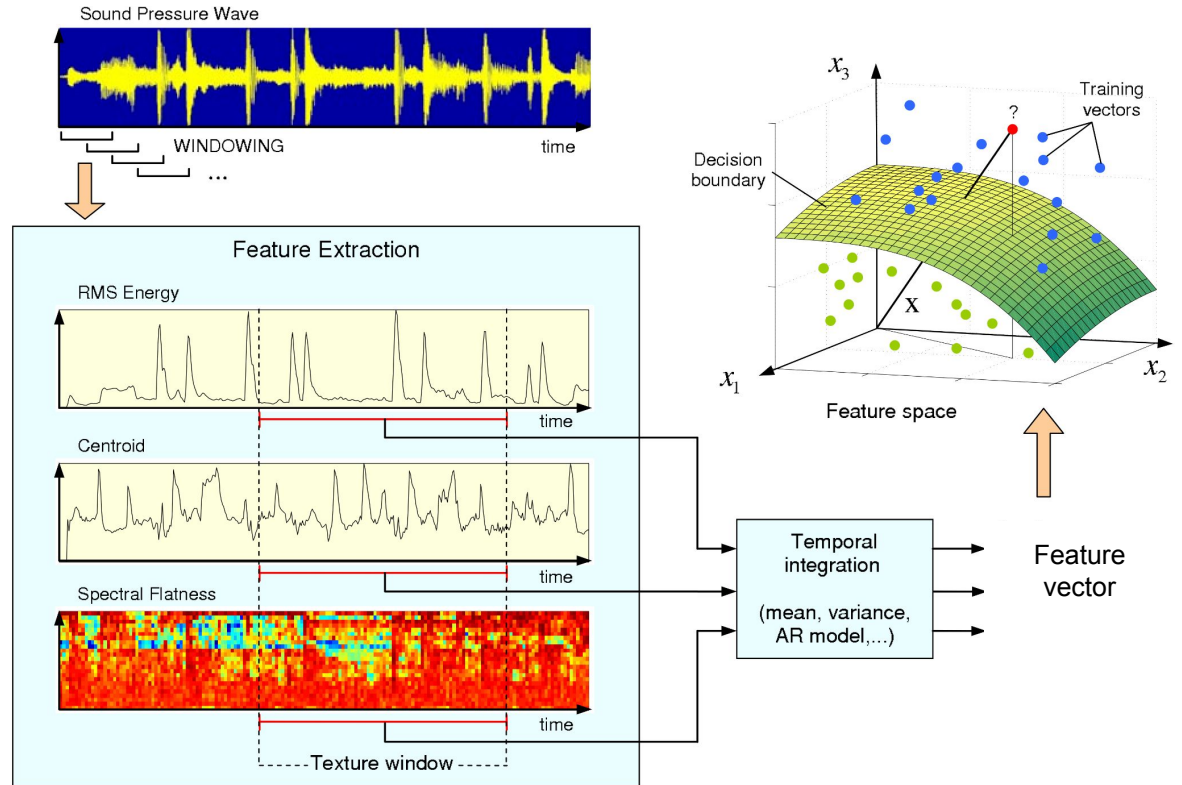
Background

Sound deconstruction

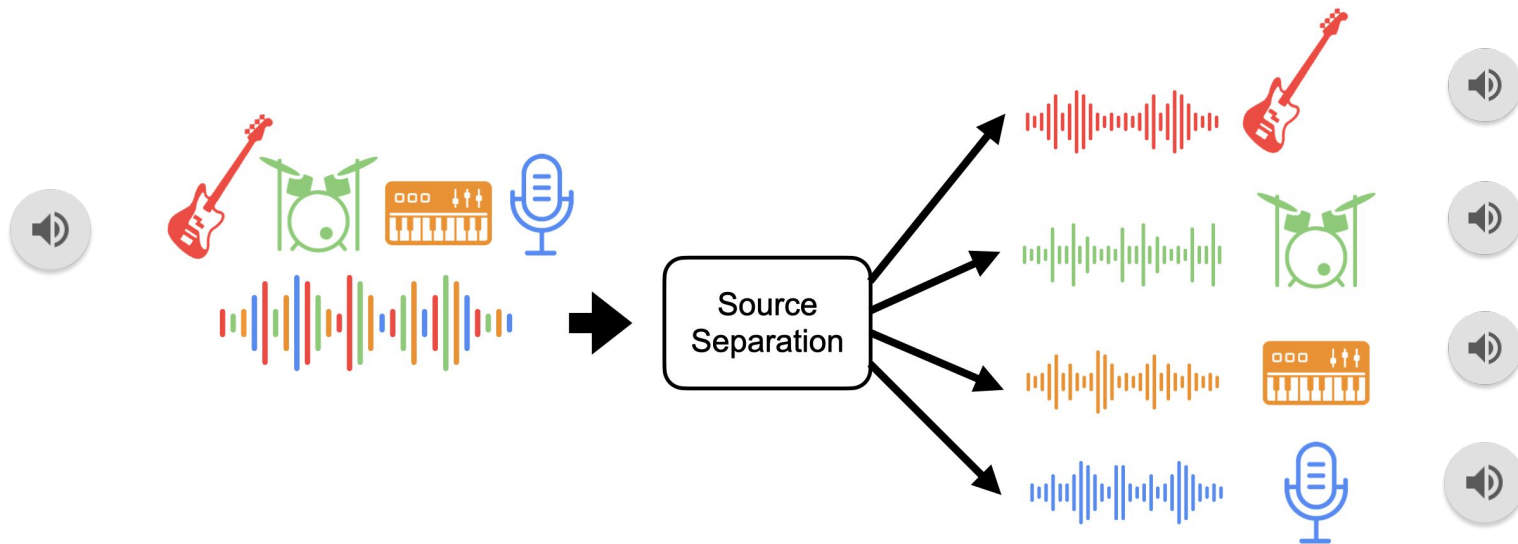
My project at CNMAT

Machine Learning and Music

- Long predates current AI boom
- Analysis, classification, transcription



Unmixing (sound source separation)




- Sound examples: Demucs (by Meta), state of the art

Unmixing Boulez

- Collaboration with Marco Stroppa and Carlo Laurenzi
- "Poésie pour pouvoir" (1958), for 3 orchestras and tape. First mixed electronic piece by Pierre Boulez
- Dissatisfied by results → withdrawn → tapes lost



Unmixing Boulez

- Only one existing mono recording 
- Reconstruction project for the Lucerne Festival
- Manually resynthesize the electronics (Csound)
- Source separation (orchestra from electronics) to help the resynthesis
 - Data augmentation with my own (open source) toolbox CLEESE
 - Supervised separation with (open source) deep neural network Demucs

recording



orchestra



electronics



Handwritten musical score for Boulez's 'Les Femmes d'Alger'. The score is annotated with blue and red markings. A red box highlights a section of the score, and blue arrows point to specific parts. Handwritten notes include '3/4 + 1/4' and '3/4 + 1/4 = 3/2'. The score is written on multiple staves, with various musical notations and symbols.

From sampling to spawning

- Collaboration with Holly Herndon and Mat Dryhurst

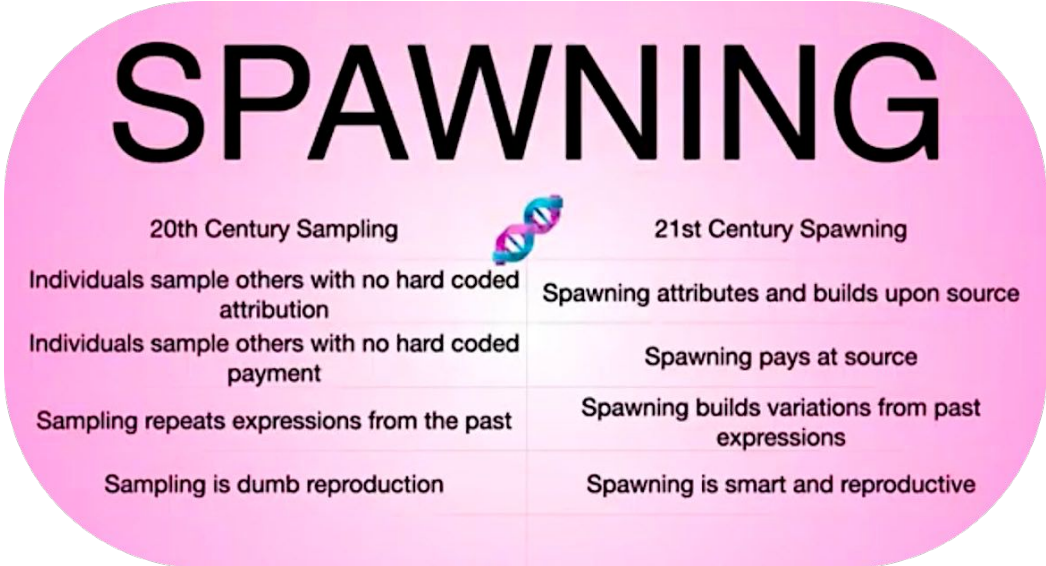


Figure by Holly Herndon

From sampling to spawning

- "Hitmaker" prototype

"I like the drum sound on that song. Generate me a set of drum hits with a similar vibe."



ideogram.ai prompt: "Phil Collins melting"

Collins meltdown!

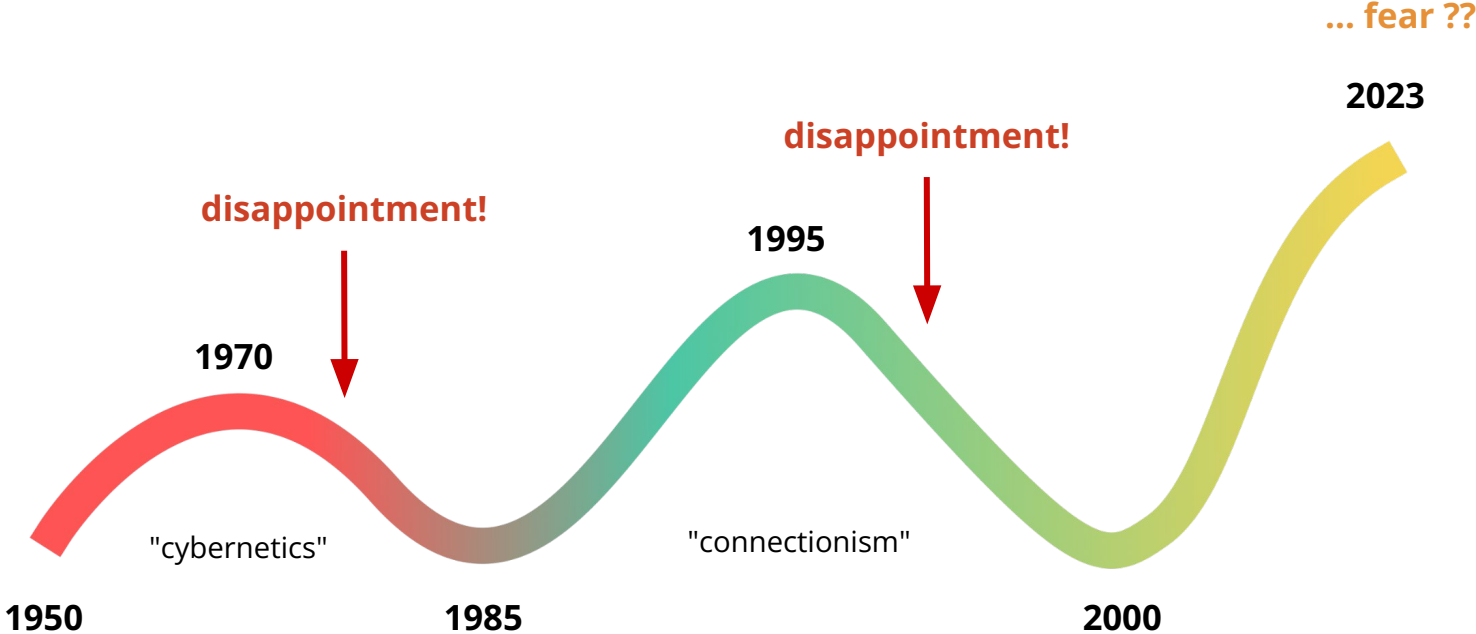


Background

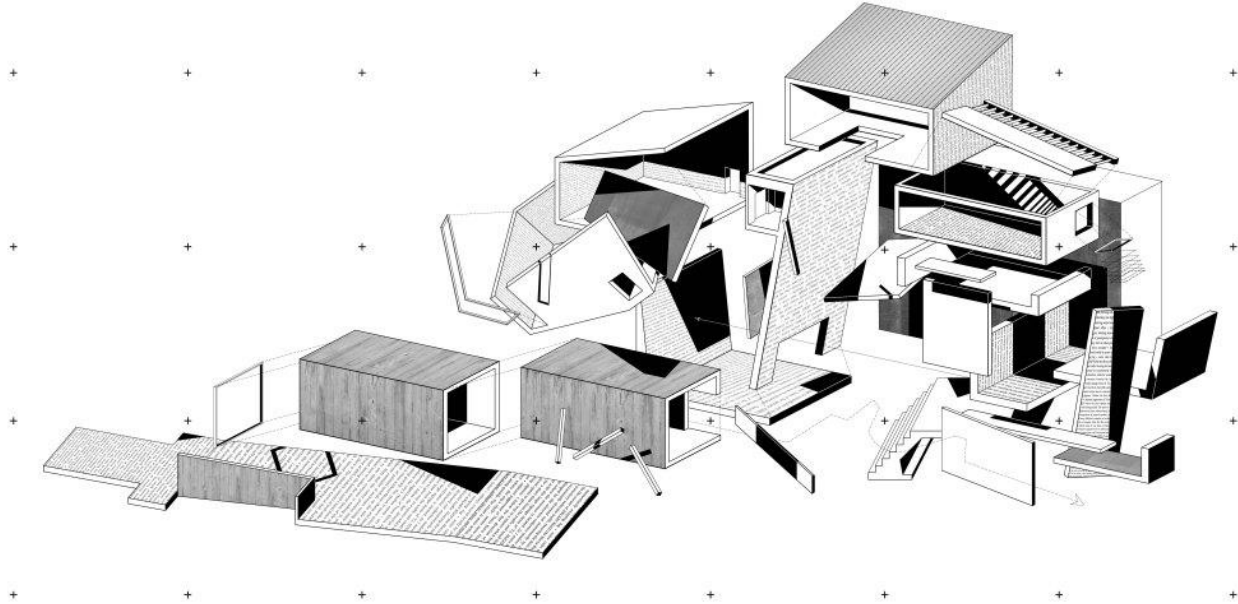
Sound deconstruction

My project at CNMAT

The waves of AI



Deconstruct to reconstruct



- Non-generative (non-interventionist) AI as a tool. Keep user engaged!

Sound deconstruction using NMF



singing bowl



creek



percussion + voice



component 1



small gushes



attacks



component 2



constant flow



mainly voices



component 3

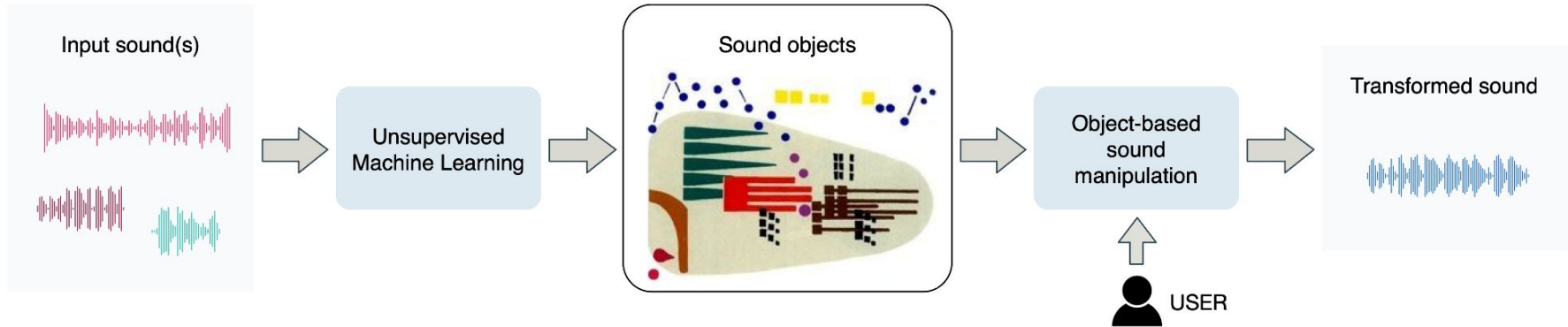


bigger gushes



chords

Sound deconstruction for manipulation

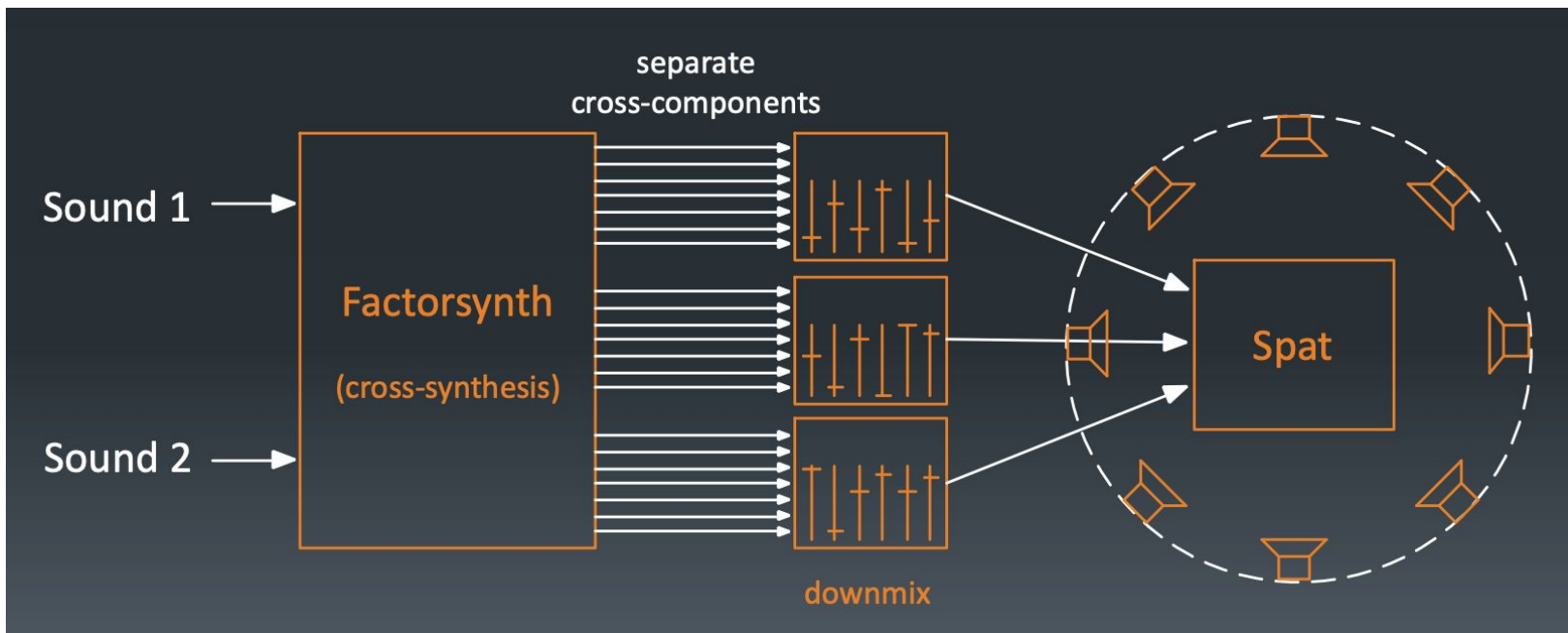


Example using early Factorsynth prototypes:

Emanuele Palumbo, "*L'Aura della Distanza*"
2017, CNSMDP (Paris Conservatory)

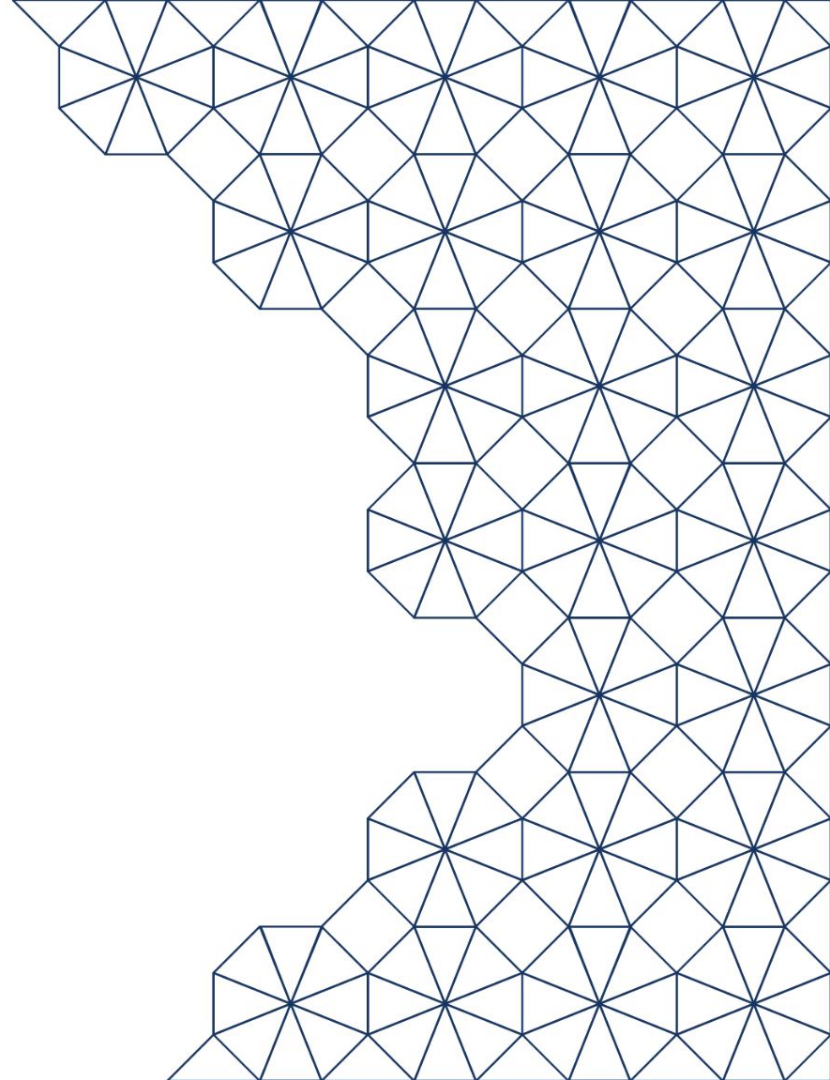


Sound deconstruction for spatialization

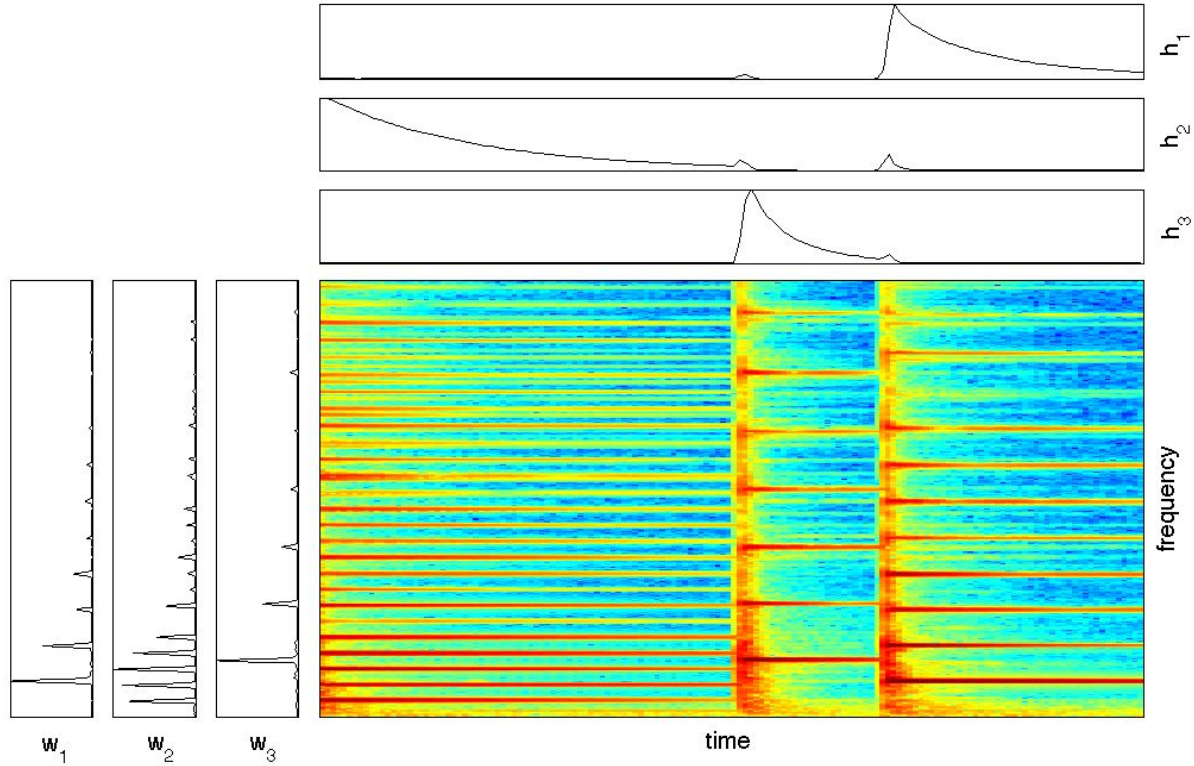


Emanuele Palumbo, "Artaud Overdrive"
2016, IRCAM

Upmixing examples



Decoupling time and frequency



Deconstruction for cross-synthesis

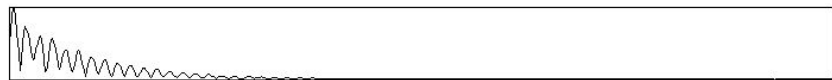


singing bowl

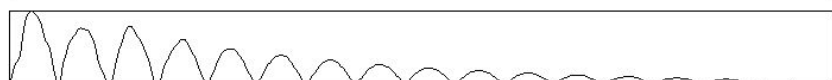
cross-components



h_1

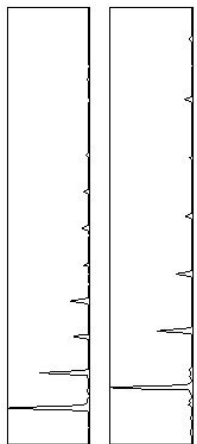


h_2



h_3

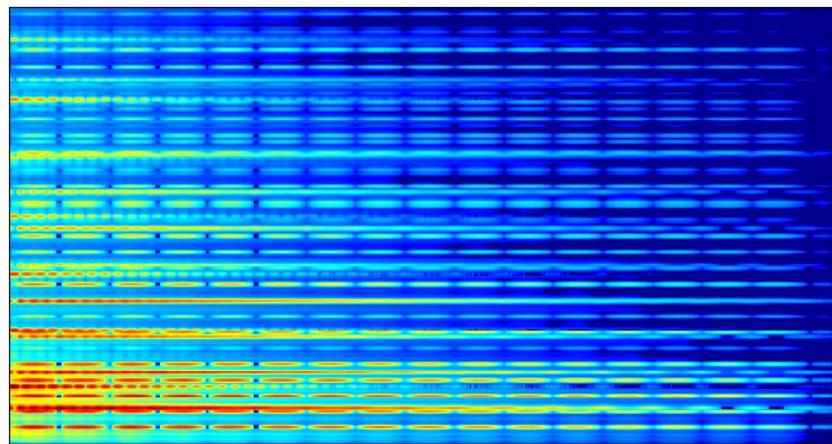
piano



w_1

w_2

w_3



frequency

time

piano / singing bowl



Wagner/Brahms x-synth



source



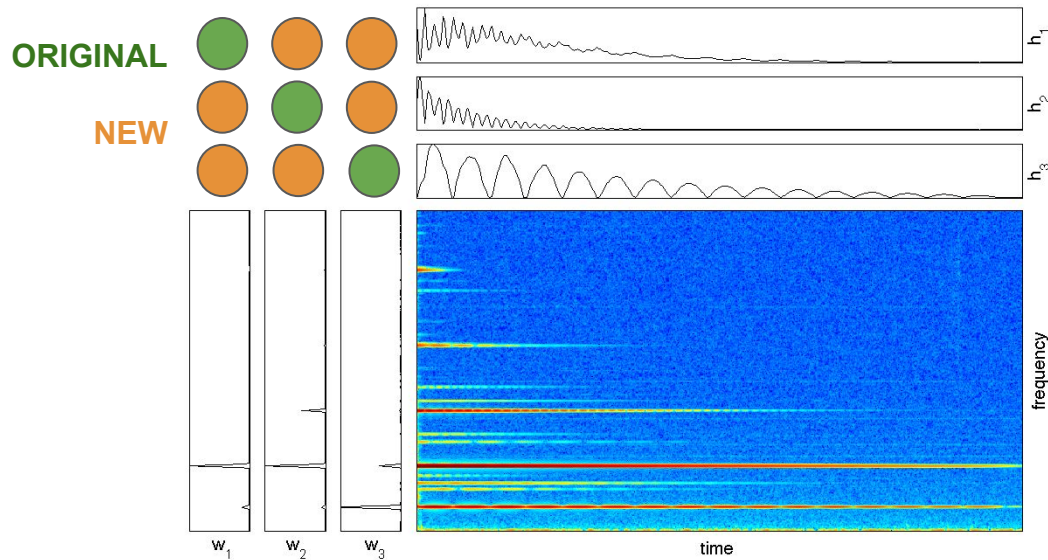
target



x-synth

Autosynthesis

- Internal cross-synthesis: temporal elements modulate unrelated spectral elements of the same sound



singing bowl



autosynth

Random Fairy-Queen



in



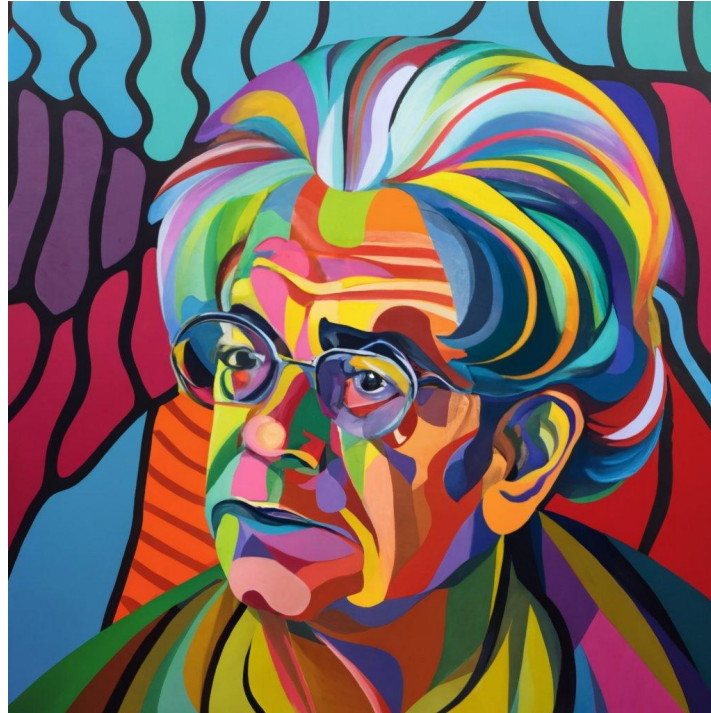
time randomization
(displacement of original
components)



timbre randomization
(random autosynthesis
connections)

Deconstruction for performance

Ligeti factorization



ideogram.ai prompt: "György Ligeti deconstruction"

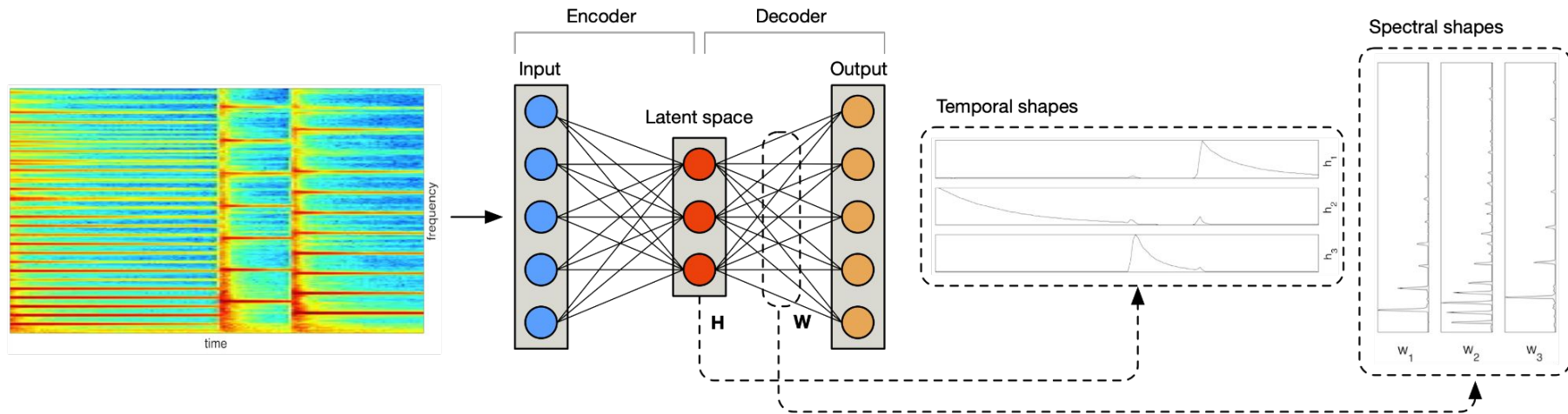
Background

Sound deconstruction

My project at CNMAT

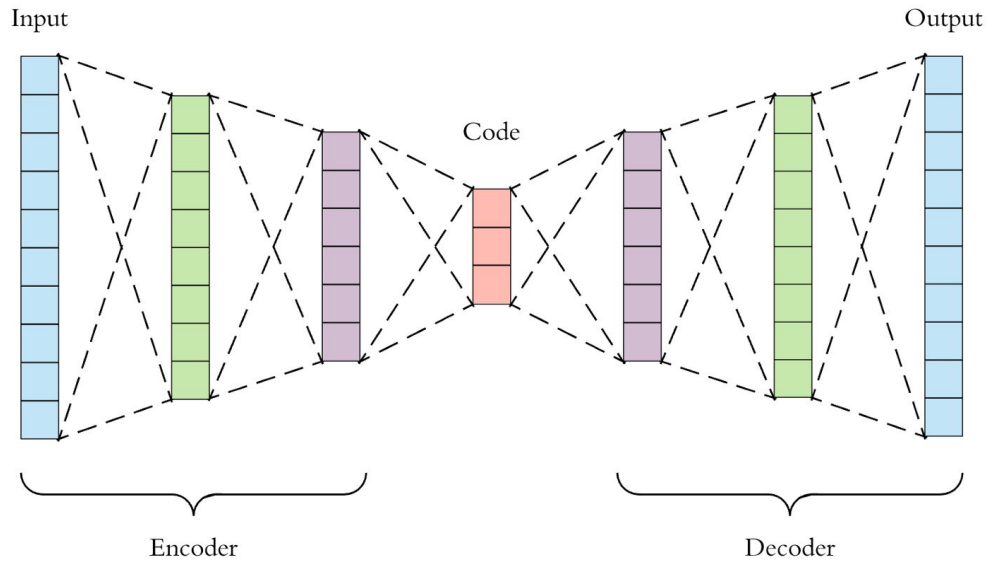
Neural sound deconstructor

- Non-negative Autoencoder (NAE)



Neural sound deconstructor

- From shallow to multiple layers: a new dimension
- Gain interpretability / flexibility



Thank you

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