



{ CONSERVATORIO
ROSSINI

hem

Haute école de musique
Genève - Neuchâtel



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



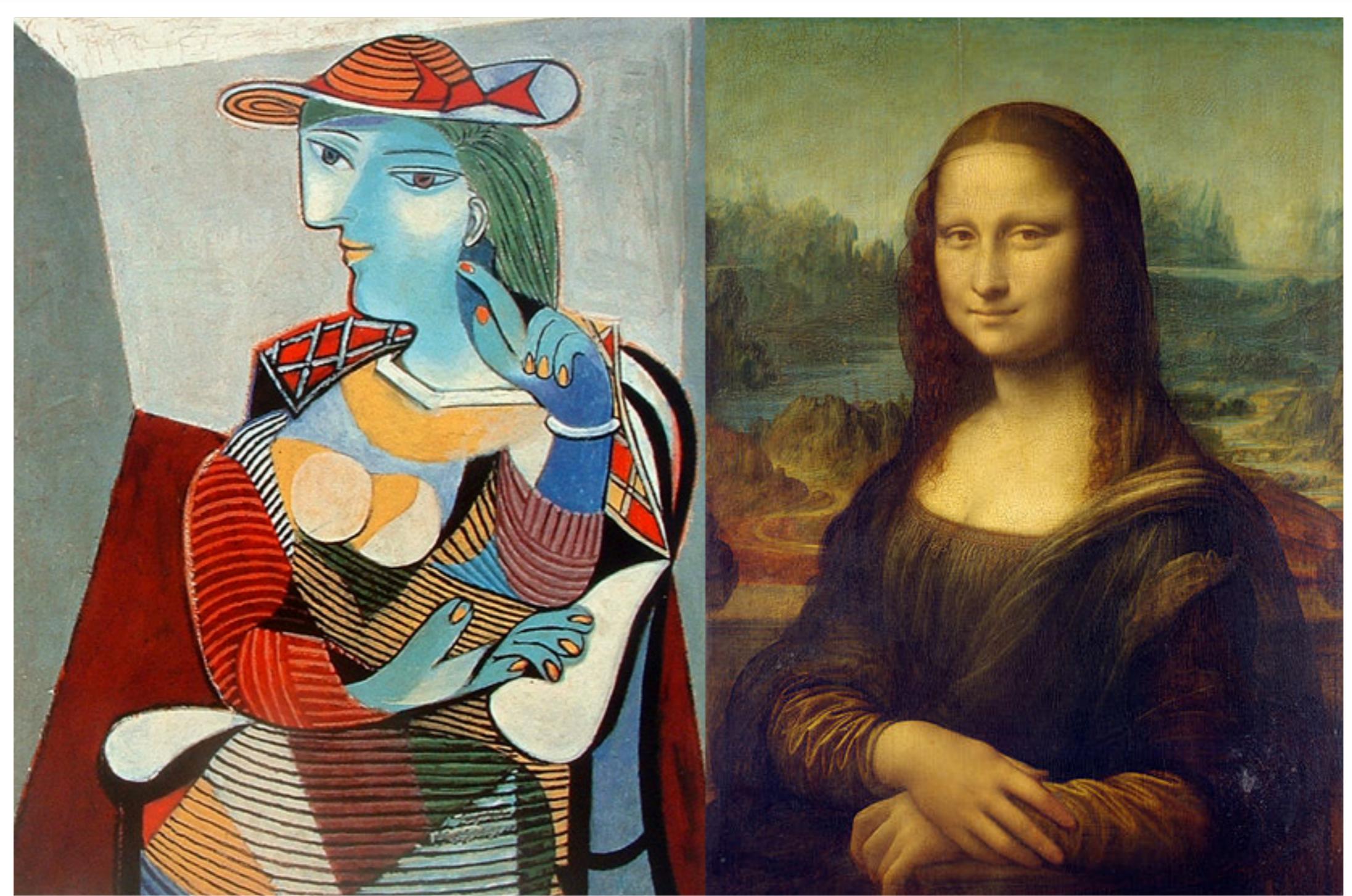
Berkeley
UNIVERSITY OF CALIFORNIA

CARMINE-EMANUELE CELLA

PLAYING THE WORLD!

AN INTRODUCTION TO AUGMENTED INSTRUMENTS

KATHARSIS AND MIMESIS



FROM PHYSICAL MODELLING TO CREATIVE MODELLING

Physical modelling
synthesis

Accurate

Real sounds (almost)



Physically inspired
synthesis

Expressive

Plausible sounds



PHYSICAL MODELLING

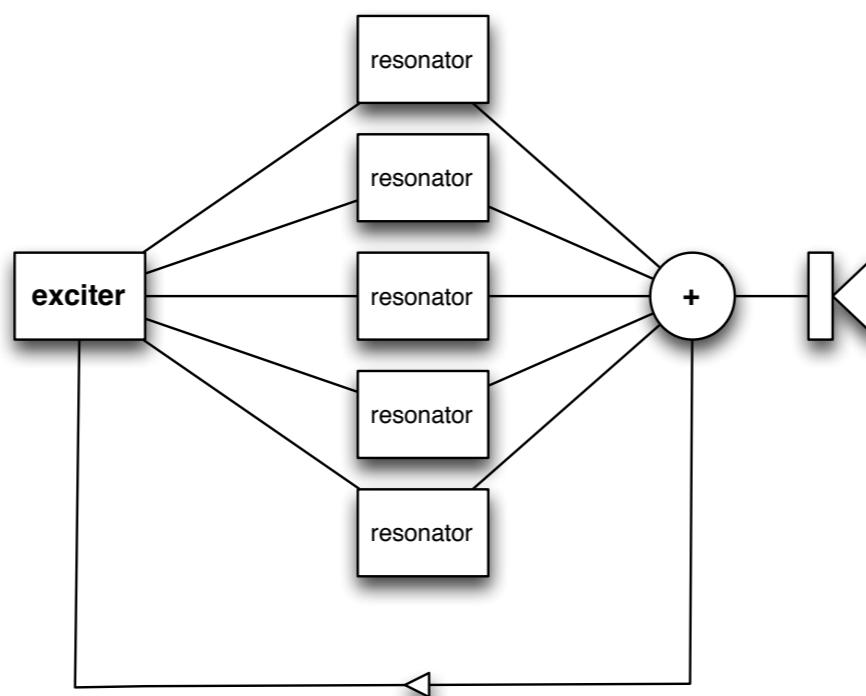
- Physical modelling synthesis generates sounds by copying the **mechanical system under vibration** and not by copying the sound itself

PHYSICAL MODELLING

- Physical modelling synthesis generates sounds by copying the **mechanical system under vibration** and not by copying the sound itself
- It is based on the solutions of the wave equation: $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$.

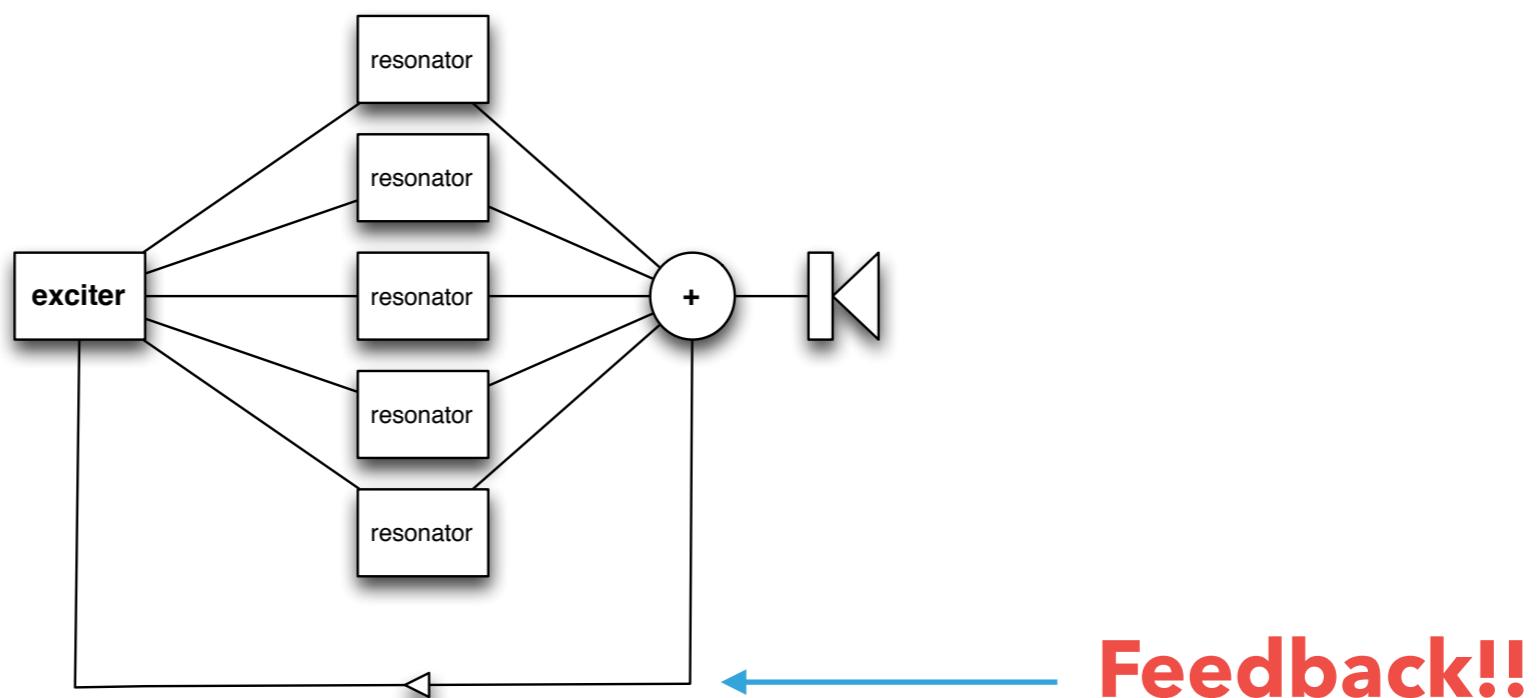
PHYSICAL MODELLING

- Physical modelling synthesis generates sounds by copying the **mechanical system under vibration** and not by copying the sound itself
- It is based on the solutions of the wave equation: $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$.
- A simplification is represented by the **exciter-resonator** system



PHYSICAL MODELLING

- Physical modelling synthesis generates sounds by copying the **mechanical system under vibration** and not by copying the sound itself
- It is based on the solutions of the wave equation: $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$.
- A simplification is represented by the **exciter-resonator** system



A CREATIVE APPROACH

- The simulation of a real vibrating object by means of modal synthesis (for example a musical instrument) can be a difficult task

A CREATIVE APPROACH

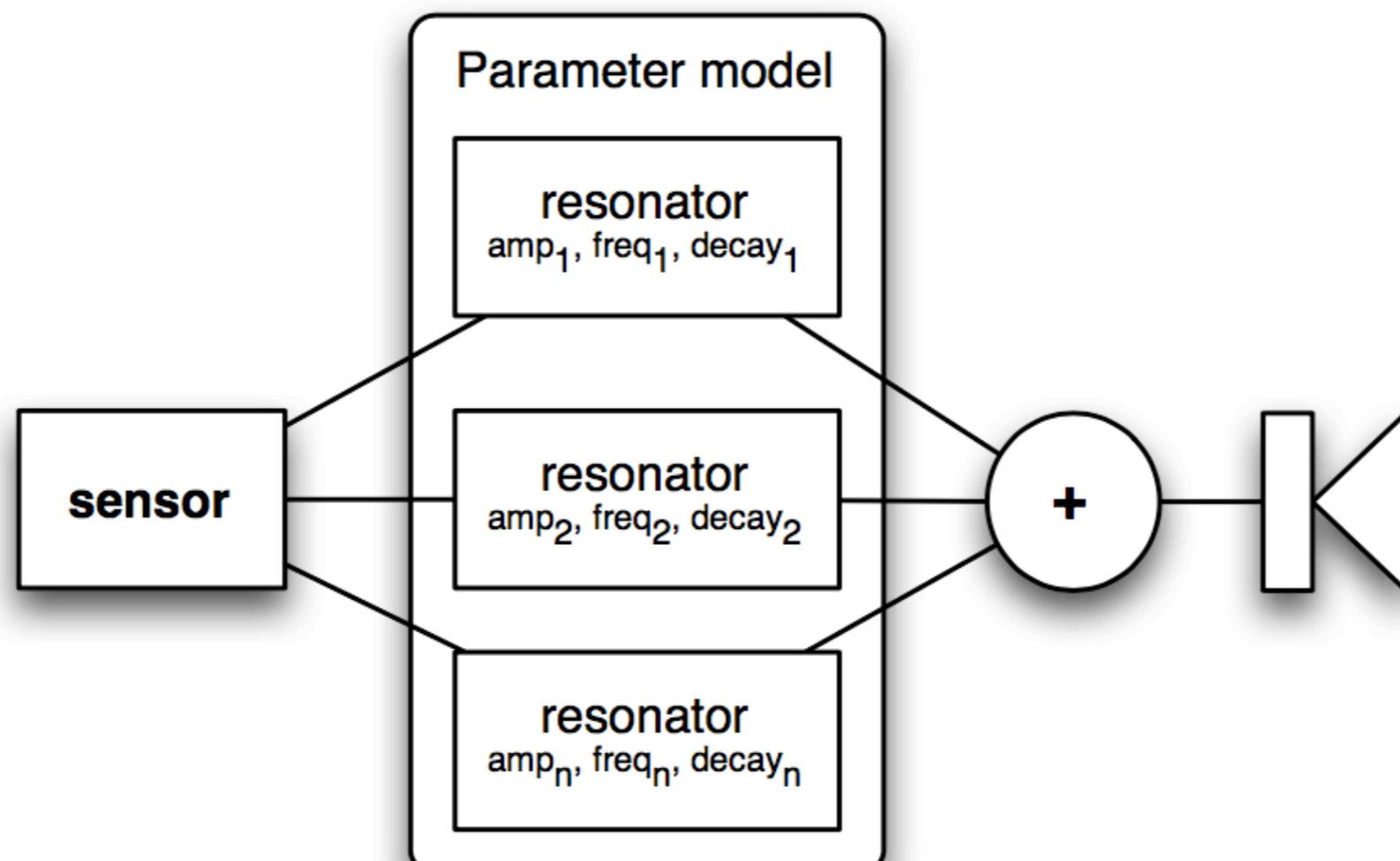
- The simulation of a real vibrating object by means of modal synthesis (for example a musical instrument) can be a difficult task
- The simulation of quasi-physical instruments can be an interesting creative activity

A CREATIVE APPROACH

- The simulation of a real vibrating object by means of modal synthesis (for example a musical instrument) can be a difficult task
- The simulation of quasi-physical instruments can be an interesting creative activity
- **Physically inspired** synthesis is variant of modal synthesis that generates sounds with special *physical* characteristics without modelling real vibrating objects

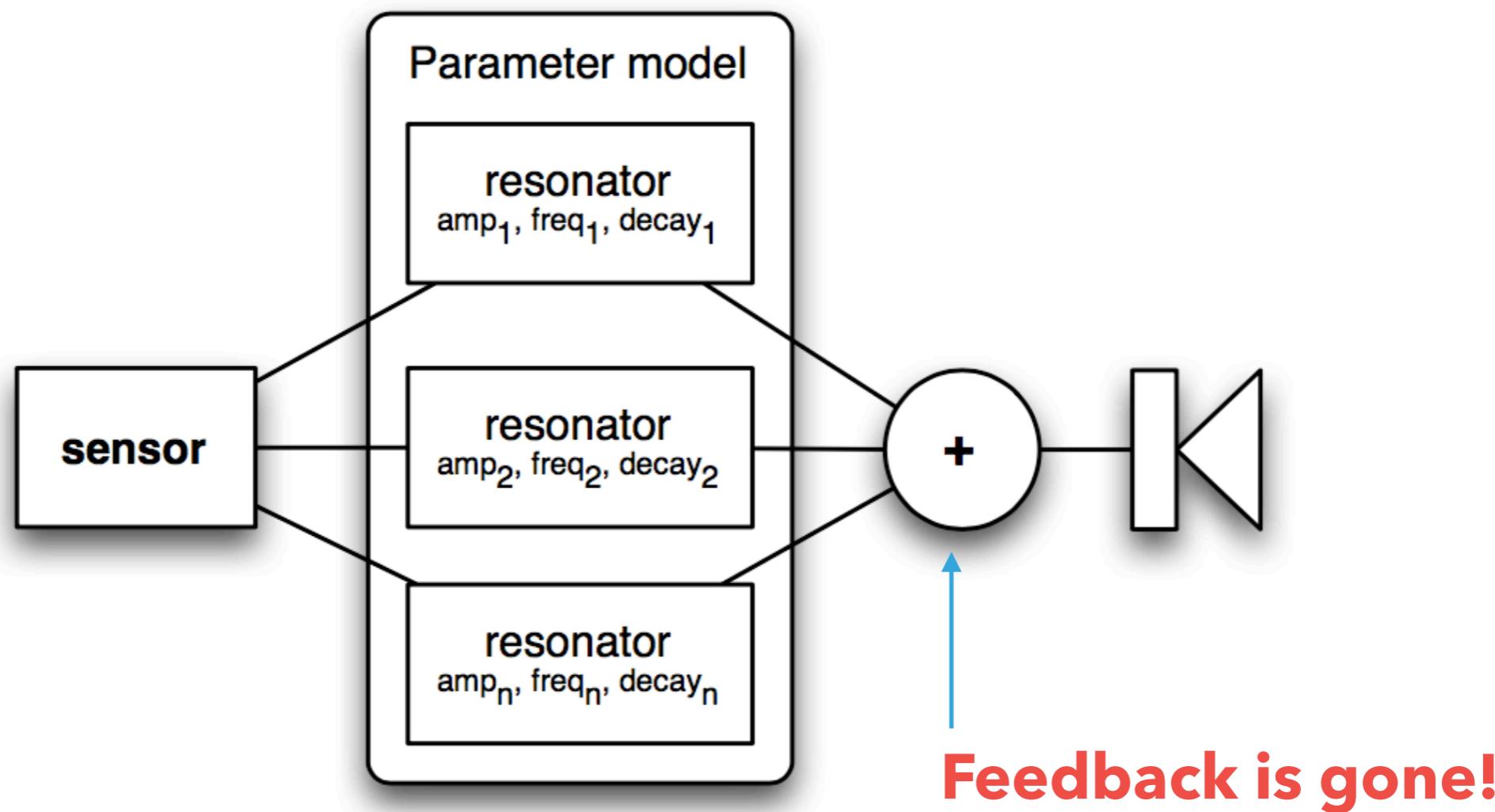
PARAMETER MODELS

In physically inspired synthesis, the feedback between the exciter and the resonators is replaced by a **parameter model** and the excitation is provided by a **sensor**

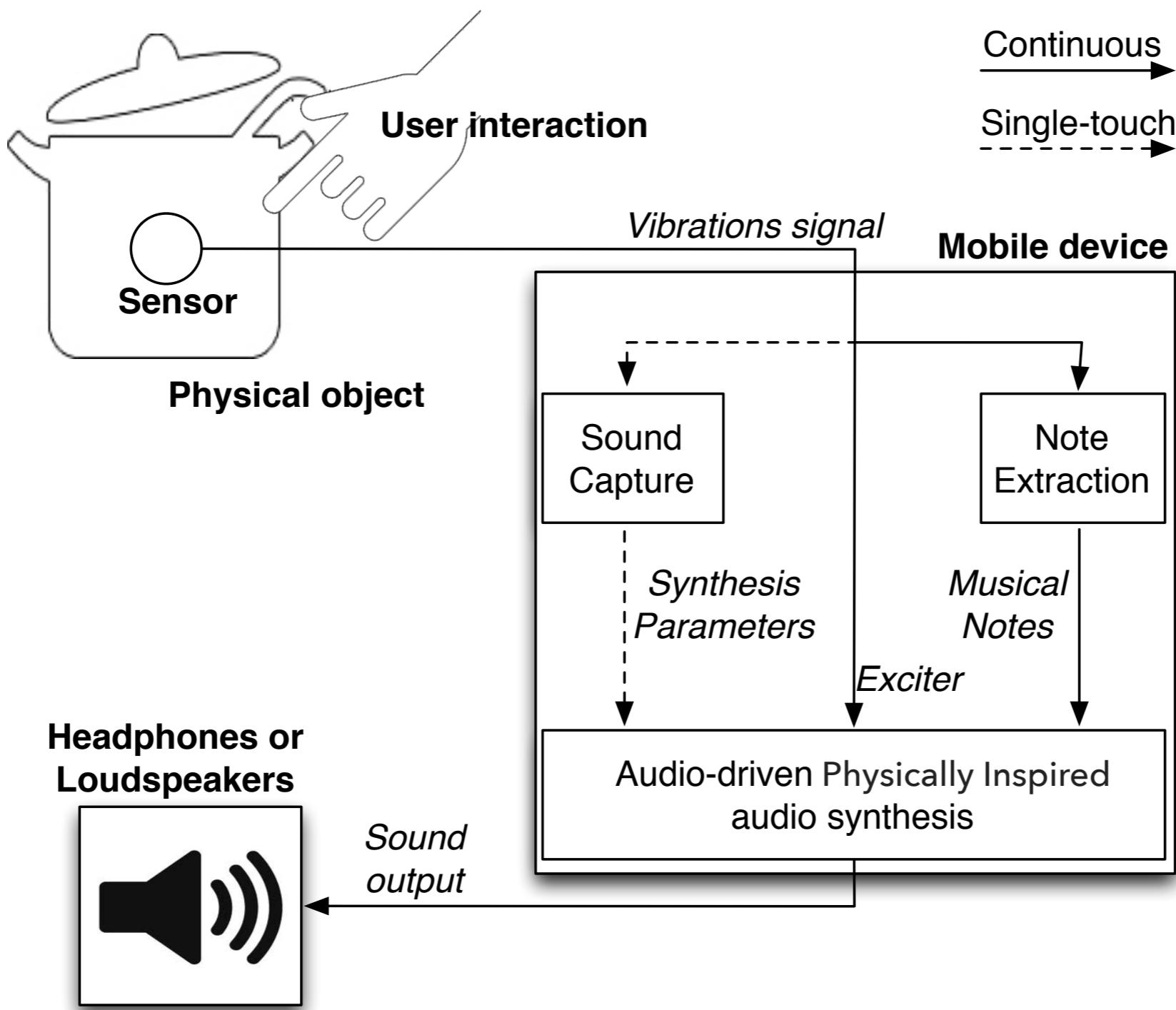


PARAMETER MODELS

In physically inspired synthesis, the feedback between the exciter and the resonators is replaced by a **parameter model** and the excitation is provided by a **sensor**



CAN WE SONIFY THE WORLD?

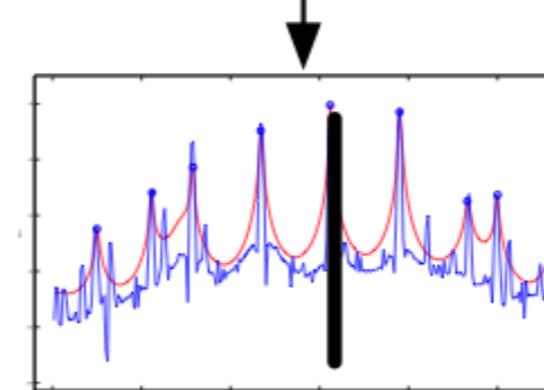
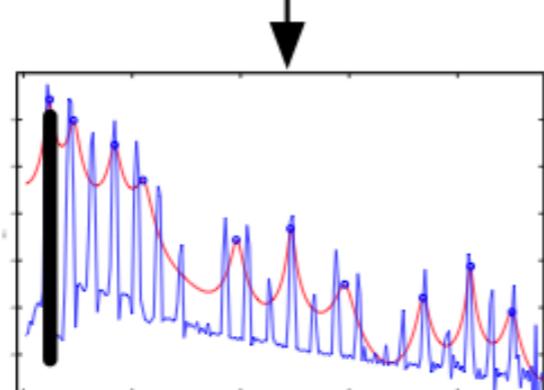


GESTURE MAPPING

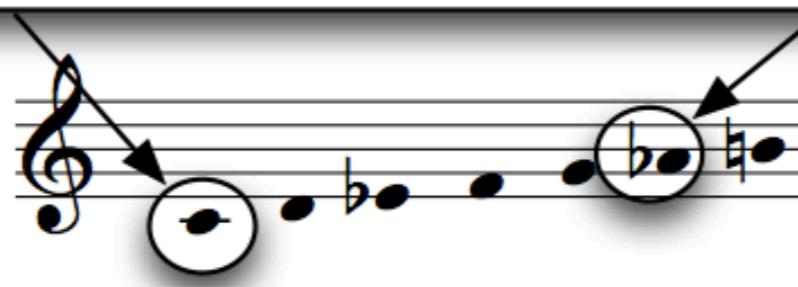
low-frequency gesture



high-frequency gesture



Mapping



SMART PERCUSSIONS (AND STUPID COMPOSER)

CARMINE-EMANUELE CELLA
INSIDE-OUT

FOR SMART PERCUSSIONS (AND STUPID COMPOSER)

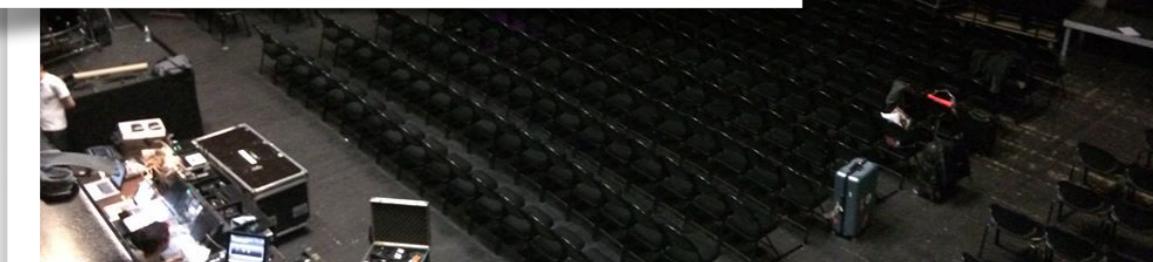
SMART PERCUSSIONS (AND STUPID COMPOSER)

CARMINE-EMANUELE CELLA
INSIDE-OUT

FOR SMART PERCUSSIONS (AND STUPID COMPOSER)

PRODUCTIONS

LES ESPACES PHYSIQUES (2017-2022)



SUMMARY

- Modelling reality means choosing an *abstraction* level (mimesis and katharsis)

SUMMARY

- Modelling reality means choosing an *abstraction* level (mimesis and katharsis)
- Physical modelling synthesis is a flexible framework to model the acoustic behaviours of physical objects

SUMMARY

- Modelling reality means choosing an *abstraction* level (mimesis and katharsis)
- Physical modelling synthesis is a flexible framework to model the acoustic behaviours of physical objects
- Physically inspired synthesis expands this possibility by creating *plausible* sounds by means of sensors and parameter models

SUMMARY

- Modelling reality means choosing an *abstraction* level (mimesis and katharsis)
- Physical modelling synthesis is a flexible framework to model the acoustic behaviours of physical objects
- Physically inspired synthesis expands this possibility by creating *plausible* sounds by means of sensors and parameter models
- Gesture recognition is the key step to create a system for **augmented reality**

GITHUB REPOSITORY OF THIS LECTURE

https://github.com/CarmineCella/HEMU_2024

SELECTED REFERENCES

- C. E. Cella, Generalized series for spectral design, 2013
- C. E. Cella, On physically inspired synthesis of sound, 2012
- C. E. Cella, Les espaces physiques (2017-2022), <https://www.youtube.com/watch?v=ZaaYmDhl5N8&t=823s>

A FULL MODEL IN ACTION

LET'S GO LIVE!

